

UPGRADING A COMPUTER'S HARD DRIVE

JANUARY 1999

Electronics NOW®

Eavesdrop on the casual chatter—or the life-and-death drama—between pilots and the ground with the

Airport Buddy

Add spectacular special effects to your home videos when you build
The Video Palette II

Build a
Garage-Door Keypad

and throw away your keys and your remote control

Working With Mixers

It's easy, as long as you follow some basic rules



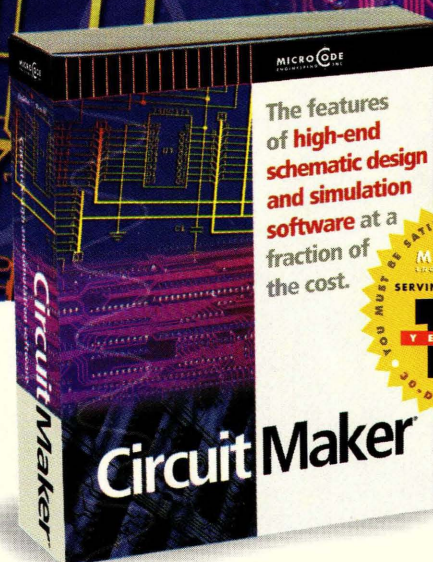
\$4.99 U.S.
\$5.99 CAN.

#BXNBQWF***** 5-DIGIT 52233
#TMMB0395R96 5#413280 OAP71
|||||
ROBERT TIMM JUL 00
SPECIALIZED SYSTEMS INC
PO BOX 395 40EN
HIAWATHA IA 52233-0395

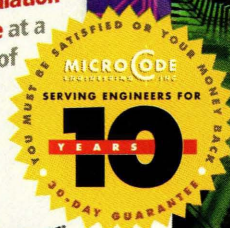
High-end features. Low-end price.

\$299

CircuitMaker 6:
Schematic design
and simulation
software



The features
of **high-end**
schematic design
and simulation
software at a
fraction of
the cost.



CircuitMaker



The features
of **high-end**
printed circuit
board layout
software at a
fraction of
the cost.

TraxMaker

\$299

TraxMaker 3:
Printed circuit
board layout
software

*CircuitMaker Version 6 and TraxMaker Version 3 give you the features of professional, high-end software at a fraction of the cost. Plus, with exceptional ease-of-use you'll spend less time learning to use the software and more time designing. Both applications are compatible with your existing software, and feature outstanding technical support. **Call now for your free functional demo.***

CircuitMaker 6 is a powerful schematic design and simulation program featuring:

- Professional schematic features including printout borders, title block and barred pin names
- Symbol editor and Macro feature for custom devices
- Fast, accurate SPICE3f5/XSPICE-based simulation
- Complete array of analysis types, including Fourier, AC, DC, Parameter sweep, Transient and more
- Virtual instruments including a digital oscilloscope, multimeter, Bode plotter, curve tracer and more
- Extensive library of over 4,000 models
- Tight integration with TraxMaker® for quick PCB layout
- Output PCB netlists in Protel®, Tango® and TraxMaker® formats for use in a variety of PCB layout programs
- Windows 3.1, 95 and NT

TraxMaker 3 is a powerful printed circuit board layout program featuring:

- Over 2,000 component footprints in a fully-documented, indexed library. Documentation shows footprints actual size
- Built-in autorouter and Design Rules Check
- Supports up to 6 signal layers plus power and ground planes, silk screen overlays and solder and paste masks
- Board sizes up to 32" x 32", with no pin limitations
- Intelligent manual routing with unrout capabilities
- Import any PCB netlist in CircuitMaker®, Protel® or Tango® format
- Output RS274X Gerber files, Excellon N/C drill files and Bill of Materials
- Print to any Windows-compatible printer or plotter
- Windows 3.1, 95 and NT

MICRO CODE
ENGINEERING INC

For free demo software, or to order, call 1-800-419-4242

927 West Center Street • Orem, UT 84057 • Phone (801) 226-4470 • Fax (801) 226-6532 • www.microcode.com

©1998 MicroCode Engineering, Inc. All rights reserved. CircuitMaker, TraxMaker, SimCode and MicroCode are registered trademarks of MicroCode Engineering, Inc. All other brand and product names are trademarks or registered trademarks of their respective companies.
CIRCLE 133 ON FREE INFORMATION CARD

CONTENTS

JANUARY 1999

ON THE COVER

25 THE AIRPORT BUDDY

Among the most boring activities known to modern Man is waiting for a flight at an airport. This month's cover story is a project that can help make that wait a little more interesting. It is an easy-to-build receiver that lets you eavesdrop on the always fascinating—and sometimes terrifying and dramatic—chatter between pilots, and between the pilots and the control tower. Once you've built one, you'll always be "in the know" while you wait for your plane.— *Anthony J. Caristi*



BUILD THIS

29 THE VIDEO PALETTE II

Need a low-cost way to add high-impact special effects to your home-video productions? This update to a popular project of years past could be just what you are looking for. — *William Sheets, K2MQJ, and Rudolf F. Graf, KA2CWL*

45 A GARAGE-DOOR KEYPAD

Are you always losing the remote control for your automatic garage-door opener? Well, build this super-secure keyless-entry system and you can stop searching. It's also great for other applications. — *Reinhard Metz and David Wickliff*

DEPARTMENTS

9 COMPUTER CONNECTIONS

Hard-disk upgrades. — *Jeff Holtzman*

12 EQUIPMENT REPORTS

Protek Scope Card 220 PC-Based Oscilloscope.

18 SERVICE CLINIC

Monitor safety, CRTs, and adjustments. — *Sam Goldwasser*

55 TECH MUSINGS

Optical rangefinding, the right way to measure AC power, and more. — *Don Lancaster*

TECHNOLOGY

13 PROTOTYPE

Wearable computers help crimefighters get the evidence, low-cost lasers, world's smallest hard disk, detecting refrozen foods, and more.

40 WORKING WITH MIXERS

Mixers are one of the most important circuits in a radio receiver, but they can be tricky to use correctly. Here are some basic rules that will make things go a lot easier. — *Joseph J. Carr*

AND MORE

2 EDITORIAL

23 LETTERS

100 ADVERTISING INDEX

4 Q&A

50 NEW LITERATURE

100 ADVERTISING SALES OFFICE

53 NEW PRODUCTS

As a service to readers, ELECTRONICS NOW publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, ELECTRONICS NOW disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

Since some of the equipment and circuitry in ELECTRONICS NOW may relate to or be covered by U.S. patents, ELECTRONICS NOW disclaims any liability for the infringement of such patents by the making, using, or selling of any such equipment or circuitry, and suggests that anyone interested in such projects consult a patent attorney.

ELECTRONICS NOW, (ISSN 1067-9294) January 1999. Published monthly by Gernsback Publications, Inc., 500 Bi-County Boulevard, Farmingdale, NY 11735-3931. Periodicals Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions \$24.99, Canada \$33.15 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries \$33.99. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies \$4.99. © 1998 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80328-5115.

A stamped self-address envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

Electronics NOW®

Hugo Gernsback (1884-1967) founder

LARRY STECKLER, EHF, CET,
Editor-in-chief and publisher

ADRIA COREN, Vice-President

KEN COREN, Vice-President

EDITORIAL DEPARTMENT

CARL LARON, editor

JOSEPH J. SUDA, technical editor

EVELYN ROSE, assistant editor

MICHAEL A. COVINGTON, N4TMI
contributing editor

SAM GOLDWASSER, service editor

JEFFREY K. HOLTZMAN,
computer editor

FRANKLIN J. MILLER,
audio editor

DON LANCASTER,
contributing editor

JANINE ABITABILE, editorial assistant

ART DEPARTMENT

ANDRE DUZANT, art director

RUSSELL C. TRUELSON, illustrator

PRODUCTION DEPARTMENT

RUBY M. YEE, production director

KATHRYN R. CAMPBELL,
production assistant

KEN COREN,
desktop production director

MELISSA GIORDANO, desktop production

CIRCULATION DEPARTMENT

THERESA LOMBARDO,
circulation manager

GINA GALLO,
circulation assistant

REPRINT DEPARTMENT

CHRISTINA M. ESTRADA, reprint bookstore

Typography by Mates Graphics

Electronics Now is indexed in *Applied Science & Technology Index*, *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*.

Microfilm & Microfiche editions are available. Contact reprint bookstore for details.

Advertising Sales Offices listed on page 100.

Electronics Now Executive and
Administrative Offices
1-516-293-3000.

Subscriber Customer Service:

1-800-999-7139.

7:00 AM-6:00 PM Monday-Friday MST

VISIT US ON THE INTERNET AT:
www.gernsback.com



Audit Bureau
of Circulations
Member

EDITORIAL

Holy Cow

You know, by now you'd think that in the realm of science and technology, very little would surprise us. After all, we've seen virtually every off-the-wall, they'll-never-be-able-to-do-that piece of sci-fi technology and gadgetry from our—and our parents'—childhoods turned into reality.

Still, every once in a while, you hear about something new that makes you just stop and say "Holy Cow" (or something similar). The other day, I had one of those experiences.

In case you missed the news reports, it seems that researchers have developed an implant that can allow paralyzed individuals to communicate directly with a computer using only brain impulses.

We don't have the space to go into the technical details here (though we are planning to do an in-depth report in a future issue). Suffice it to say that one completely paralyzed volunteer (though alert and intelligent, he was unable to speak or move any limb) is now able to control a cursor on a laptop well enough to be able to stop it on an icon and click it.

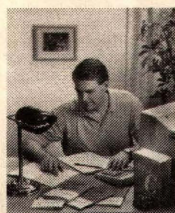
That ability allows him to use the computer to say words and phrases. Researchers have even added an alpha-numeric keypad on which the patient has been practicing writing his own name, and they hope that the patient will become proficient enough in using his thoughts to control a computer to be able to go online and generate and send e-mail.

Progress has been slow, but the fact that there has been any progress at all seems mind boggling. Further, the implications here are staggering, because once you can control a computer using only thoughts, you can control almost anything. There is now hope that someday paralyzed individuals will be able to regain at least some mobility, as well as the ability to communicate effectively. For the rest of us, well, there seems to be no limit to the possibilities.

Carl Laron
Editor

Affordable Hi-Tech Training!

Announcing New Micro Courses from the CIE Bookstore.



Easy at-home learning.

Cleveland Institute of Electronics has created a collection of micro courses that focus on our most popular subjects.

Offered through our bookstore, every micro course leads to a Certificate of Completion once finished. Each course may contain up to 39 lessons with exams and many have lab exercises, training videos or software to supplement your studies. Experience a step-by-step program designed specifically for the independent study student.

Enroll now and receive student privileges that include **Instructor Assistance***, **Priority Grading and Student Resources.**

These privileges will allow you to access our faculty and staff if you ever need assistance with your course work and insure that your submitted exams will be graded and sent back to you within 24 hours.



Programmable Controllers Micro Course

This course starts by explaining how a Programmable Controller (PLC) functions in an

automated system. Learn about the parts of a PLC which enable it to perform its function. Look at a typical application and learn how to develop a written program for it.

01-PC01.....\$65

(This micro course would make a great addition to the videos listed below. 01-567PLC)

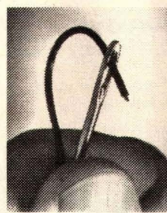
8-Part PLC Video Training Set

Contains 4 hours of video lessons and a 146 page study guide. These easy-to-follow video lessons will make learning this vital information fast & easy. This 8-part training course is designed to take 32 hours.

However, you can study at your own pace & review each lesson as many times as you need! Video set does not include certificate of completion. 01-567PLC **\$180.00**

Subjects Covered In the Video Training Set:

- How process control works
- PLC advantages
- PLC disadvantages
- Identifying PLC sections
- Move functions
- How to read flow charts
- Troubleshooting techniques
- Identify logic faults
- PLC servo control
- Scanning sequence
- Timer instructions
- Counter instructions
- Output instructions
- Identify input faults
- Identify output faults
- Plus much more!



Fiber Optics Course

Apply what you have learned in this course to install, diagnose and repair complex fiber-optic communications systems and take your place in the forefront of a

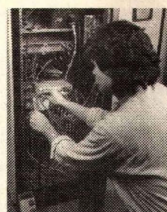
fascinating and challenging new technology.

CIE Lesson & Exam Material Covers:

- Troubleshooting Fiber Optics • Characteristics of Fiber Optics • Fiber-Optic Communications Modules • Light • Laser Atomic Physics
- Practical Lasers • Modulating the Laser Beam • Masters • Laser Applications
- Maintenance of Lasers & Laser Systems

Video & Workbook Material:

- Understanding Fiber Optics
- 01-FB01 **\$125**



AC/DC Basic Electronics with Lab

39 lessons with lab. All this knowledge & support will put you on the road to understanding many areas of electronics.

03-INTRO **\$195**

CIE Soldering Course with Lab

3 lessons with lab, soldering iron & video tape.

01-SD01 **\$95**

Television Diagnosis & Repair Course

12 lessons, 5 videos & technician repair software.

01-TV01 **\$345**

Computer Programming in C

10 lessons, text, study guide & software package

04-CET352 **\$275**

Database Management

6 lessons, dBASE III software (student version)

01-DB01 **\$195**

Computer Aided Circuit Design & Drafting with Lab

16 lab assignments, Micro-Cap III (student version) 04-CET351 **\$195**

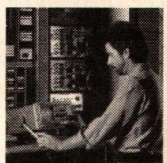
Introduction to Computers

8 lessons on the basics, video. 01-IN01 .. **\$195**

Automotive Electricity & Electronics Course

5 lessons, 150 piece Auto Electrical Tool Kit

01-AU01 **\$195**



Oscilloscope Fundamentals

Learn fundamental principles common to all oscilloscopes. 1 lesson, video and workbook. 01-SCP01...**\$95**



Microprocessor Theory & Applications

Learn operation & architecture of a microprocessor. Program in machine and assembly language. 17 lessons, lab & video. 03-MICRO .. **\$475**

FCC Exam Review Course

25 lessons to prepare you for general-class license. FCC ID software. 01-FCC01 **\$295**

CET Exam Review Course

1 lesson to prepare you for Associate-Level CET test. Answer practice test questions that will cover all areas of the test. 01-CT01 **\$65**

*Some courses include non-CIE material (videos) that will supplement your studies but will not be included under Instructor Assistance.

Start your training today!



Call: 1-800-321-2155
or fax: 1-440-951-2186

Send check, money order or credit card information to: CIE 1776 E. 17th Street
Cleveland, OH 44114 or call 1-800-321-2155.

Name _____

Street _____

City _____

State _____ Zip _____

Phone Number _____

Enter Micro Course Number and Price.

OH RESIDENTS ADD 7 %	
SHIPPING & HANDLING**	
TOTAL	

_____ VISA _____ MasterCard _____ Discover

Exp. Date _____

Account Number _____

Signature _____ Date _____

SHIPPING & HANDLING CHARGES:

\$50.01 - \$100.....\$10.25 \$200.01 - \$400.....\$25.75
\$100.01 - \$200...\$15.75 \$400.01 - Over...\$31.00

** Foreign shipping costs will be higher.
Call for rates.

MC04

Call 1-800-321-2155 or fax 1-440-951-2186 to place an order. CIE: 1776 E. 17th Street, Cleveland, Ohio 44114. www.cie-wc.edu

Q & A

READERS' QUESTIONS, EDITORS' ANSWERS
CONDUCTED BY MICHAEL A. COVINGTON, N4TMI

What Is Ground?

Q I have a beginner's question about the article you wrote, "Build the No-Parts PIC Programmer (NOPPP), which appeared in the September 1998 issue of *Electronics Now*, and about other project circuits. The diagram shows one common ground, but the picture of the NOPPP shows two pins both labeled "ground." Are they connected together? Are all these ground pins connected to the negative side of the batteries or power supplies? "Ground" is a confusing idea for me; I've read several basic books but none of them seem to explain it.—E. I., Durham, NC

A In my early days, "ground" puzzled me too. I knew that electrical power systems are grounded (connected to the earth) for safety reasons, and antenna systems sometimes use the earth as a counterpoise. But that didn't explain why almost all circuits have ground symbols in their schematics, even small battery-operated devices that can't possibly be connected to the earth.

Eventually I came across a book that defined "ground" as "common negative," or more generally, "common," and the light dawned.

Look at the diagram in Figure 1, which shows an imaginary but typical circuit (it could be some kind of DC amplifier). The diagram on the left uses the ground symbol; the diagram on the right does not.

The right-hand diagram shows that one side of the input, one side of the output, and one side of the battery are all connected together via the line at the bottom. This connection is "common to" (shared by) the input, output, and power supply. In the diagram on the left, the common connection is denoted by the ground symbol.

All the points marked by the ground symbol are connected together. Where the diagram shows only one connection for a two-terminal device, such as a battery, microphone, or speaker, the

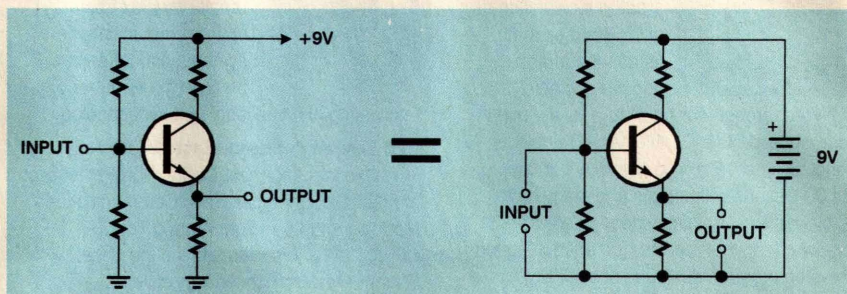


FIG. 1—A GROUND SYMBOL IN A SCHEMATIC shows points that are connected to each other and to the common side of the power supply, input, and output. As a result, these two simplified circuits are identical. Despite the term, ground does not imply a connection to the circuit's enclosure or to the Earth.

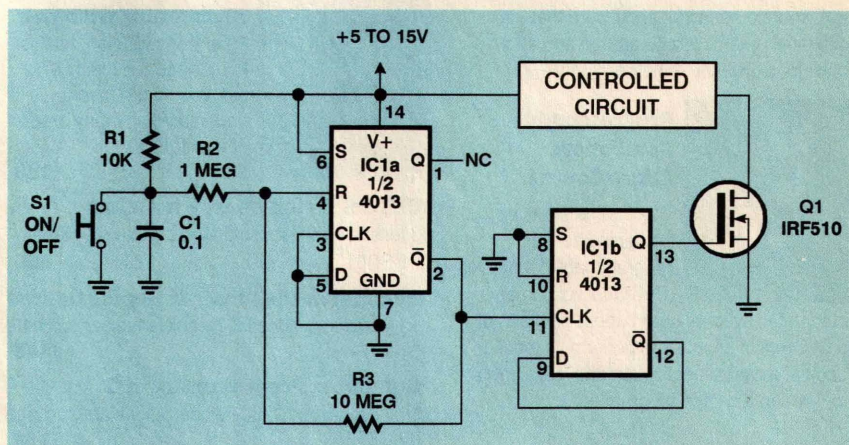


FIG. 2—HERE'S THE PUSH-ON, PUSH-OFF circuit that was originally published in the April 1998 installment of this column.

other terminal always goes to ground. Likewise, the "voltage at" any point in a circuit is measured by connecting a voltmeter between that point and ground. Cable shields are usually connected to ground.

Ground isn't always negative. A power supply marked -9V, as in an op-amp circuit, could consist of a battery with the negative terminal connected to that point and the positive terminal grounded. If the circuit shows +9V, -9V, and ground, it usually means that two batteries or the equivalent are involved, connected in series with the midpoint grounded.

Push-On, Push-Off, Again...

Q In the "Push On, Push-Off" circuit in your April 1998 column (and reprinted here as Fig. 2), the last paragraph states, "A disadvantage of the circuit is that you can't predict the state of the flip-flop when power is first applied."

I think you can force IC1b into the reset state with an RC delay circuit (see Fig. 3). While the capacitor charges, the reset pin is held high by the charging current; then the resistor holds the reset pin low so the flip-flop can function normally. When power is turned off, the diode rapidly discharges the capacitor to protect the IC, and the series resistor, R5,

HOW TO GET INFORMATION ABOUT ELECTRONICS

On the Internet: See our Web site at <http://www.gernsback.com> for information and files relating to our magazines (**Electronics Now** and **Popular Electronics**) and links to other useful sites.

To discuss electronics with your fellow enthusiasts, visit the newsgroups sci.electronics.repair, sci.electronics.components, sci.electronics.design, and rec.radio.amateur.homebrew. "For sale" messages are permitted only in rec.radio.swap and misc.industry.electronics.marketplace.

Many electronic component manufacturers have Web pages; see the directory at <http://www.hitex.com/chipdir/>, or try addresses such as <http://www.ti.com> and <http://www.motorola.com> (substituting any company's name or abbreviation as appropriate). Many IC data sheets can be viewed online. Extensive information about how to repair consumer electronic devices and computers can be found at www.repairfaq.org.

Books: Several good introductory electronics books are available at RadioShack, including one on building power supplies.

An excellent general electronics textbook is *The Art of Electronics*, by Paul Horowitz and Winfield Hill, available from the publisher (Cambridge University Press, 1-800-872-7423) or on special order through any bookstore. Its 1125 pages are full of

information on how to build working circuits, with a minimum of mathematics.

Also indispensable is *The ARRL Handbook for Radio Amateurs*, comprising 1000 pages of theory, radio circuits, and ready-to-build projects, available from the American Radio Relay League, Newington, CT 06111, and from ham-radio equipment dealers.

Copies of past articles: Copies of past articles in **Electronics Now** and **Popular Electronics** (post 1994 only) are available from our Clagg, Inc., Reprint Department, P.O. Box 4099, Farmingdale, NY 11735; Tel: 516-293-3751.

Electronics Now and many other magazines are indexed in the *Reader's Guide to Periodical Literature*, available at your public library. Copies of articles in other magazines can be obtained through your public library's interlibrary loan service; expect to pay about 30 cents a page.

Service manuals: Manuals for radios, TVs, VCRs, audio equipment, and some computers are available from Howard W. Sams & Co., Indianapolis, IN 46214 (1-800-428-7267). The free Sams catalog also lists addresses of manufacturers and parts dealers. Even if an item isn't listed in the catalog, it pays to call Sams; they may have a schematic on file which they can copy for you.

Manuals for older test equipment and ham radio gear are available from Hi Manuals, PO Box 802, Council Bluffs, IA 51502, and Manuals Plus, PO Box 549, Tooele, UT 84074.

Replacement semiconductors: Replacement transistors, ICs, and other semiconductors, marketed by Philips ECG, NTE, and Thomson (SK), are available through most parts dealers (including RadioShack on special order). The ECG, NTE, and SK lines contain a few hundred parts that substitute for many thousands of others; a directory (supplied as a large book and on diskette) tells you which one to use. NTE numbers usually match ECG; SK numbers are different.

Remember that the "2S" in a Japanese type number is usually omitted; a transistor marked D945 is actually a 2SD945.

Hamfests (swap meets) and local organizations: These can be located by writing to the American Radio Relay League, Newington, CT 06111; (<http://www.arrl.org>). A hamfest is an excellent place to pick up used test equipment, older parts, and other items at bargain prices, as well as to meet your fellow electronics enthusiasts—both amateur and professional.

limits the current applied to the reset pin under power supply transient conditions—Charles Hansen, Tinton Falls, NJ

A Thank you very much for a reliable, conservatively designed circuit modification. Not everyone would have thought of including the diode and R5, which aren't necessary under most conditions but are desirable to keep from overstressing the IC's input protection diodes and thereby make the chip last longer. We checked, and the 4013 data sheet doesn't specify any limits on rise or fall time of the reset signal, so there's no need for a Schmitt trigger or transistor in the reset circuit, as there would be with a microcontroller.

... And Again ...

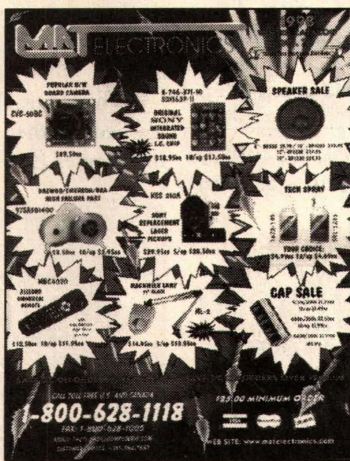
Q I'm sending you a simpler push-on, push-off circuit that I've always had good luck with (see Fig. 4). I used a 74C74. The debouncing is done by R1 and C1. From my experience, the Q output is always 0 (low) at power-up.—A. M. DePaz, Globe, AZ

A Thanks for the circuit; it's a nice example of something that works better than it ought to (so to speak). According to the 74C74 data sheet, the flip-flop won't operate reliably unless the input signal makes the transition from low to high in less than 5 nanoseconds. In your circuit, the transition may or may not be that fast, depending on the impedance of the power supply. Fortunately, the flip-flop is clocked by the capacitor charging (which happens very fast), not discharging (a much slower process).

More importantly, there is no reason to expect the flip-flop to always power up in a particular state, though you may well

MAT ELECTRONICS®

Over 20 years of dependable service to the industry



**Call now
for FREE
116 PAGE
CATALOG!**

TV/VCR PARTS • CHEMICALS
• SURVEILLANCE EQUIPMENT
• AUDIO/VIDEO
ACCESSORIES • MATV, CATV
& DSS PRODUCTS •
MICROWAVE OVEN PARTS •
TOOLS AND SERVICE AIDS
• BATTERIES • ANTENNAS •
TELEPHONE ACCESSORIES •
VIDEO GAME ACCESSORIES
• COMPUTER PARTS &
ACCESSORIES



"The On Time Electronics Distributor"



**CALL TOLL-FREE
1-800-628-1118**

FAX: 1-800-628-1005

VISA

MasterCard

Discover

MAT ELECTRONICS
400 Pike Road
Huntingdon Valley, PA 19006

WEB SITE: www.matelectronics.com
EMAIL: 74271.645@compuserve.com

have found one, or even a whole batch, that are "set in their ways" and happen to work consistently because of a mismatch between transistors on the chip.

As the diagram shows, the set and reset pins of the 74C74 are active low (not high) and are therefore inactivated by connecting them to V+ rather than ground. A similar circuit with a 4013 would work (or not work) about as well, with the set and reset pins grounded.

... And Finally!

While researching these questions I came across a completely different way to build a push-on, push-off circuit (see Fig. 5). Two inverter gates make a Schmitt trigger that uses a capacitor for memory as well as debounce. The circuit always powers up with the load turned off, then switches on or off every time you press the button.

This is an adaptation of a circuit by T. J. Byers originally published in *Nuts and Volts*, May 1998. Here's how it works: Positive feedback ensures that the output of the second gate is always either fully "off" or fully "on." The output of the first gate is always in the opposite state.

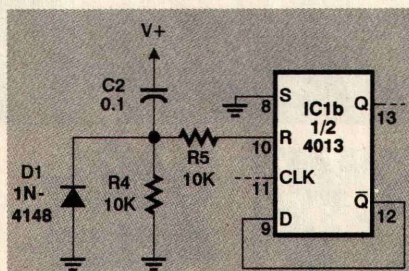


FIG. 3—THIS MODIFICATION TO APRIL'S circuit guarantees that the circuit is off when power is first applied.

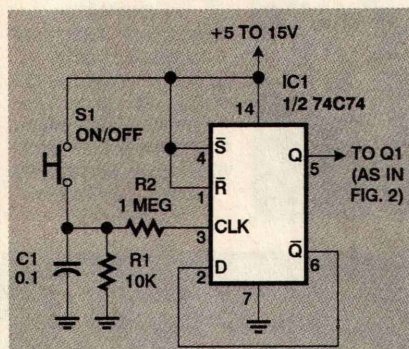


FIG. 4—WHILE UNDER SOME circumstances, the circuit shown here will work as a push-on, push-off switch, it relies on undocumented performance of the flip-flop. Also note that the flip-flop requires a fast-rising input signal.

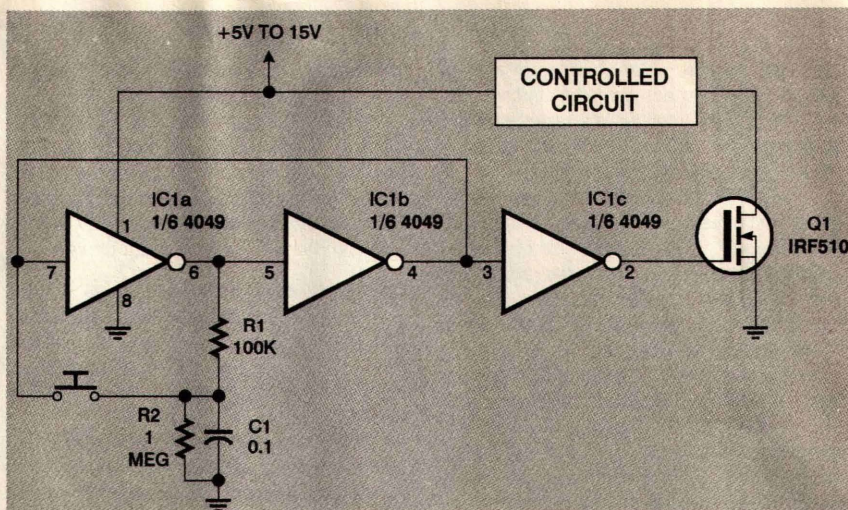


FIG. 5—HERE'S YET ANOTHER push-on, push-off switch. It draws less than one μ A of current when in the "off state." Be sure to ground the unused inputs of IC1.

Resistor R2 ensures that the capacitor will be discharged if the circuit has been off for a while, so at power up, the output of the first gate is low. It stays that way until you press the button and connect the capacitor to the output of the second gate, which is high. Then the Schmitt trigger changes state; the output of the first gate goes high and keeps the capacitor charged. When you press the button again, the point to which you will be connecting the capacitor is now low, so the circuit will change state again. Debouncing is provided by the fact that the capacitor takes some time to charge. Unfortunately, the button is not returned to ground, so the buttons in some keypads are not usable.

While breadboarding this circuit, I learned another way *not* to use a digital multimeter (see Fig. 6). The power sup-

ply voltage seemed to be fluctuating strangely, in a staircase pattern, as the circuit switched on and off. Why? Because my autoranging digital multimeter, set on a low mA range, was changing its resistance as it automatically switched from one range to another. I turned off autoranging and everything was fine again. More tricks of modern technology!

Connecting Two Telephones Together

Q I have several ordinary telephones like you would find in a house. My daughters enjoy playing with them. Is there any way to connect the phones together so they can actually talk to each other without going through the phone line? Of course I would like them to ring when calling each other.—B. G., Clintwood, VA

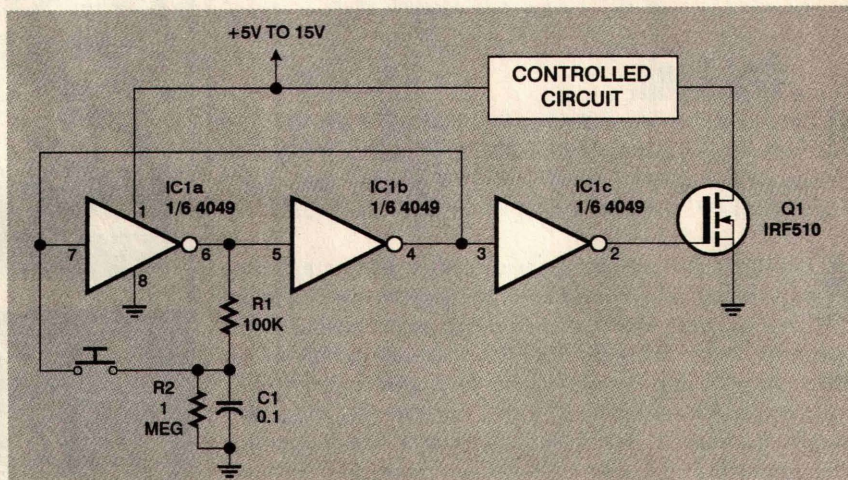


FIG. 6—AS THIS AUTHOR LEARNED from experience, avoid this situation when taking measurements with an autoranging meter. Otherwise, you'll get erratic results caused by changing meter resistance as the unit switches from range to range.

A What you propose is actually a handy way to test telephones. Connect them in series with a 6- to 9-volt battery (see Fig. 7). Current flows only when both phones are off the hook; hanging up either one turns off the circuit. The usual polarity is green positive, red negative (possibly the only place in electronics where red doesn't indicate positive), but very few telephones are sensitive to polarity.

Ringling is the hard part. It requires 90 volts AC, together with a circuit to sense that the telephone is on the hook before applying the ringing voltage. I suggest you set up a separate buzzer for signaling, as the telephone company used to do for telephone intercoms.

Which PIC To Pick?

Q I'm building the NOPPP PIC programmer in your September issue and don't know which variety of PIC16C84 chip to buy. The types available include PIC16C84-04IP, -04ISO, -04P, -04SO, -10EP, -10IP, -10ISO, -10P, -10SO, and possibly others. The article does not specify which version should be used. Can you tell me which chip to use and where to get one? — M. B., Phoenix, AZ

A Sorry about the confusion—many ICs, including these, are made in a wide variety of subtypes that are almost completely interchangeable. The differences are explained in the manufacturer's data book.

The most obvious difference is the package; you want the P package (plastic DIP), not SO (surface mount). (Some PICs, though not this one, also come in a JW package, which is a ceramic DIP with a quartz window for UV erasing.)

The second difference is the temperature range; I and E denote extended ranges, and the versions without those letters are cheaper. Finally, there are both 4-MHz and 10-MHz versions of this chip. So the PIC16C84-04P and PIC16C84-10P are the ones to order, the latter only if you need to run the clock faster than 4 MHz.

Many distributors' catalogs explain these differences, at least briefly. Digi-Key (701 Brooks Ave. South, Thief River Falls, MN 56701; Tel: 800-DIGIKEY; Web: www.digikey.com) has a nice set of catalog pages that will help you pick the right PIC; they sell the chips at reasonable prices with no minimum order. You

can also get the most common PICs from Jameco (1355 Shoreway Road, Belmont, CA 94002; Tel: 650-592-8097; Web: www.jameco.com) and many other suppliers.

Audio Clean-Up Software Found

In the September issue, a reader asked about software to remove scratches and noise from old audio recordings that have been digitized

using a sound card. Richard Dzick, N8MQU, advises us that such a feature is included in the deluxe edition of Adaptec Easy CD Creator. The new tool is called "CD Spin Doctor." The basic edition of Easy CD Creator, without the audio clean-up software, is bundled with many CD-R drives. Adaptec, Inc., can be contacted at 691 South Milpitas Boulevard, Milpitas, CA 95035; Tel: 408-945-8600; Fax: 408-262-2533; Web: www.adaptec.com. They also supply cables for linking your stereo to your computer, as well as many other input-output products.

AT \$299.95, NO OTHER DESIGN WORKSTATION GIVES YOU SO MUCH FOR SO LITTLE.

Function Generator
...sine/square/triangle
...plus TTL

Triple Power Supply
...5V fixed, plus
two variable ± 1.3 to ± 15 V DC
with short circuit
protection

**8 TTL Logic
Probe Indicators**

Audio Speaker

**Two Digital
Pulsers**

**Two BNC Connectors
for oscilloscopes
and counters**

**Available now
assembled or
in kit form**

**OVER \$600 WORTH
OF WORLD CLASS
TEST EQUIPMENT
FOR UNDER \$300!**

**Remainder
of trainer now has
a 3 YEAR warranty**

The PB-503 is a total design workstation. It has everything! **Instrumentation**, including a function generator with continuously variable sine/square/triangle wave forms—plus TTL pulses. **Breadboards** with 8 logic probe circuits.

And a **Triple Power Supply** with fixed 5VDC, plus two variable 1.3 outputs (+1.3 to 15VDC and -8 to 15VDC). Throw in 8 TTL compatible LED indicators, switches, pulsers,

potentiometers, audio experimentation speaker...plus a lifetime guarantee on all breadboarding sockets! You have everything you need right there in front of you! PB-503—one super test station for under \$300! Order yours today!!

**GLOBAL
SPECIALTIES**



**Can't Wait! Call Toll-Free For More Information
1-800-572-1028**
or the name of your local distributor
OR VISIT OUR WEB SITE AT www.globalspecialties.com
70 Fulton Terrace, New Haven, CT 06512
(203) 466-6103 • Fax: (203) 468-0060

an
Interphase
Industries
company

Accredited B.S. Degree in Computers or Electronics

by studying at Home

Grantham College of Engineering
offers 3 distance education programs:

- B.S.E.T. emphasis in Electronics
- B.S.E.T. emphasis in Computers
- B.S. in Computer Science

NEW! -Electronics Workbench Professional 5.0
included in our B.S.E.T. curriculums
-Approved by more than 200 Companies,
VA and Dantes, (tuition assistance avail.)

For your free catalog of our programs dial

1-800-955-2527

<http://www.grantham.edu>

GCE

Your first step
to help yourself
better your future!

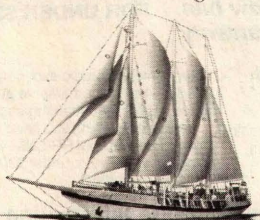


Grantham College of Engineering
34641 Grantham College Road
Slidell, LA 70460-6815

Some Say Watching Tropical
Fish Lowers Blood Pressure
& Relieves Stress...



They Could Be On To
Something.



Discover the Caribbean aboard a Tall Ship.
6 & 13 day adventures from \$650.
For more information call your travel agent
or 1-800-327-2601.

**Windjammer
Barefoot Cruises**

P.O. Box 190120, Dept. 5569 Miami Beach, FL 33119

CIRCLE 132 ON FREE INFORMATION CARD

UNITED STATES POSTAL SERVICE Statement of Ownership, Management, and Circulation (Required by 39 USC 3685)

1. Publication Title: **ELECTRONICS NOW**

2. Issue Frequency: **MONTHLY**

3. Issue Date: **06/01/99**

4. Number of Issues Published Annually: **12**

5. Annual Subscription Price: **\$19.97**

6. Complete Mailing Address of Known Office of Publication (Not printer): **500 BI-COUNTY BLVD., FARMINGDALE NY 11735**

7. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not printer): **500 BI-COUNTY BLVD., FARMINGDALE NY 11735**

8. Owner: **PERREIRA, LINDA MARCO**

9. Full Name and Complete Mailing Address of Publisher: **PERREIRA, LINDA MARCO 500 BI-COUNTY BLVD., FARMINGDALE NY 11735**

10. Full Name and Complete Mailing Address of Managing Editor: **LARRY STRICKLER 500 BI-COUNTY BLVD., FARMINGDALE NY 11735**

11. Full Name and Complete Mailing Address of Circulation Manager: **CARL LARSEN 500 BI-COUNTY BLVD., FARMINGDALE NY 11735**

12. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of all individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a proprietor, give the name and address.)

13. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box ☒ None

14. Tax Status (For completion by nonprofit organizations authorized to mail at special rates. Check one)

15. Section 501(c)(3) ☒ Yes ☐ No

16. Section 501(c)(6) ☐ Yes ☐ No

13. Publication Title	14. Issue Date for Circulation Data Below
ELECTRONICS NOW	JUNE 1999
1. Extent and Nature of Circulation	
a. Total Number of Copies (Net press run)	140,833
b. Paid and/or Requested Circulation	20,318
c. Paid or Requested Mail Subscriptions (Include advertiser's proof of payment and other supporting data)	59,742
d. Total Paid and/or Requested Circulation (Sum of 13b and 13c)	80,060
e. Free Distribution by Mail (Carriers, street vendors, and other means)	8,925
f. Free Distribution Outside the Mail (Carriers or other means)	8,925
g. Total Free Distribution (Sum of 13e and 13f)	88,985
h. Total Distribution (Sum of 13d and 13g)	169,045
i. Copies not Distributed	71,788
j. Total (Sum of 13h and 13i)	240,833

17. Signature and Title of Editor, Publisher, Business Manager, or Owner: **PERREIRA, LINDA MARCO**

18. Date: **10/8/99**

Instructions to Publishers: 1. Complete and file one copy of this form with your postmaster annually on or before October 1. Keep a copy of the completed form for your records. 2. In cases where the stockholder or security holder is a trustee, include in items 10 and 11 the name of the person or corporation for whom the trustee is acting. Also include the names and addresses of individuals who are stockholders who own or hold 1 percent or more of the total amount of bonds, mortgages, or other securities of the publishing corporation. In item 11, if none, check the box. Use block initials if more space is required. 3. Be sure to furnish all circulation information called for in item 15. Free circulation must be shown in item 15a, e, and f. 4. If the publication has been published at a special or reduced rate, the Statement of Ownership, Management, and Circulation must be published. It must be printed in any issue in October or, if the publication is not published during October, the first issue after October. 5. In item 16, indicate the date of the issue in which this Statement of Ownership will be published. 6. Item 17 must be signed. 7. Signatures and titles of individuals who are authorized to sign on behalf of the publisher. 8. Signature and title of the publisher. 9. Signature and title of the business manager. 10. Signature and title of the owner. 11. Signature and title of the editor. 12. Signature and title of the circulation manager. 13. Signature and title of the advertising manager. 14. Signature and title of the general manager. 15. Signature and title of the president. 16. Signature and title of the vice president. 17. Signature and title of the secretary. 18. Signature and title of the treasurer. 19. Signature and title of the controller. 20. Signature and title of the assistant controller. 21. Signature and title of the assistant treasurer. 22. Signature and title of the assistant controller. 23. Signature and title of the assistant treasurer. 24. Signature and title of the assistant controller. 25. Signature and title of the assistant treasurer. 26. Signature and title of the assistant controller. 27. Signature and title of the assistant treasurer. 28. Signature and title of the assistant controller. 29. Signature and title of the assistant treasurer. 30. Signature and title of the assistant controller. 31. Signature and title of the assistant treasurer. 32. Signature and title of the assistant controller. 33. Signature and title of the assistant treasurer. 34. Signature and title of the assistant controller. 35. Signature and title of the assistant treasurer. 36. Signature and title of the assistant controller. 37. Signature and title of the assistant treasurer. 38. Signature and title of the assistant controller. 39. Signature and title of the assistant treasurer. 40. Signature and title of the assistant controller. 41. Signature and title of the assistant treasurer. 42. Signature and title of the assistant controller. 43. Signature and title of the assistant treasurer. 44. Signature and title of the assistant controller. 45. Signature and title of the assistant treasurer. 46. Signature and title of the assistant controller. 47. Signature and title of the assistant treasurer. 48. Signature and title of the assistant controller. 49. Signature and title of the assistant treasurer. 50. Signature and title of the assistant controller. 51. Signature and title of the assistant treasurer. 52. Signature and title of the assistant controller. 53. Signature and title of the assistant treasurer. 54. Signature and title of the assistant controller. 55. Signature and title of the assistant treasurer. 56. Signature and title of the assistant controller. 57. Signature and title of the assistant treasurer. 58. Signature and title of the assistant controller. 59. Signature and title of the assistant treasurer. 60. Signature and title of the assistant controller. 61. Signature and title of the assistant treasurer. 62. Signature and title of the assistant controller. 63. Signature and title of the assistant treasurer. 64. Signature and title of the assistant controller. 65. Signature and title of the assistant treasurer. 66. Signature and title of the assistant controller. 67. Signature and title of the assistant treasurer. 68. Signature and title of the assistant controller. 69. Signature and title of the assistant treasurer. 70. Signature and title of the assistant controller. 71. Signature and title of the assistant treasurer. 72. Signature and title of the assistant controller. 73. Signature and title of the assistant treasurer. 74. Signature and title of the assistant controller. 75. Signature and title of the assistant treasurer. 76. Signature and title of the assistant controller. 77. Signature and title of the assistant treasurer. 78. Signature and title of the assistant controller. 79. Signature and title of the assistant treasurer. 80. Signature and title of the assistant controller. 81. Signature and title of the assistant treasurer. 82. Signature and title of the assistant controller. 83. Signature and title of the assistant treasurer. 84. Signature and title of the assistant controller. 85. Signature and title of the assistant treasurer. 86. Signature and title of the assistant controller. 87. Signature and title of the assistant treasurer. 88. Signature and title of the assistant controller. 89. Signature and title of the assistant treasurer. 90. Signature and title of the assistant controller. 91. Signature and title of the assistant treasurer. 92. Signature and title of the assistant controller. 93. Signature and title of the assistant treasurer. 94. Signature and title of the assistant controller. 95. Signature and title of the assistant treasurer. 96. Signature and title of the assistant controller. 97. Signature and title of the assistant treasurer. 98. Signature and title of the assistant controller. 99. Signature and title of the assistant treasurer. 100. Signature and title of the assistant controller.



A public service of this magazine

Timid about getting on the... World Wide Web?

You've heard about the *Information Superhighway* and all the hype that goes with it! Sort of makes you feel timid about getting on the Web. Put your fears aside! A new book, **The Internet and World Wide Web Explained**, eliminates all the mystery and presents clear, concise information to build your confidence. The jargon used is explained in simple English. Once the tech-talk is understood, and with an hour or two of Web time under your belt, your friends will believe you are an Internet guru!

To order Book #BP403 send \$10.95 plus \$4.00 for shipping in the U.S. and Canada only to Electronics Technology Today Inc., P.O. Box 240, Massapequa Park, NY 11762-0240. Payment in U.S. funds by U.S. bank check or International Money Order. Please allow 6-8 weeks for delivery.

Writing to Q&A

As always, we welcome your questions. The most interesting ones are answered in print. Please be sure to include plenty of background information (we'll shorten your letter for publication) and give your full name and address (we'll only print your initials). If you are asking about a circuit, please include a complete diagram. Send your letters to Q&A, **Electronics Now Magazine**, 500 Bi-County Blvd., Farmingdale, NY 11735. Sorry, but due to the volume of mail we receive, it is not possible to give personal replies. **EN**

To learn how to talk with your kids
about tough issues, like sex,
AIDS/HIV and violence, call
1-800-CHILD-44
and get your free guidebook.



Hard Disk Upgrades

CONSIDER THE FOLLOWING SITUATION: LOW DISK SPACE AND LAGGING PERFORMANCE ON A 180-MHZ PENTIUM PRO SYSTEM WITH 64 MB OF RAM. THE SYSTEM IS USED PRIMARILY FOR SOFTWARE DEVELOPMENT UNDER A VARIETY OF OPERATING

systems, including DOS 6.2, Windows 3.1, Windows 95, Windows 98, Windows NT 3.51, and Windows NT 4.0. The collection of operating systems is spread across three IDE hard drives mounted in plug-in cartridges, primarily to accommodate isolated test environments for the several operating systems. The main drive also uses the excellent System Commander to boot multiple operating systems.

Here are the possible solutions: 1) Buy a new machine, and reinstall everything. The only problem here is the high cost and the huge time drain. 2) Add a hard disk to the primary controller and use it as secondary storage, leaving the existing drives as is. 3) Add new drive as primary storage and continue using existing drives as operating system (OS) plug-ins.

The best solution, at least in my eyes is the last: I obtained a fast new hard-disk, a new controller, and some utility programs; installed it; transferred everything on the main drive to the new drive; disabled the old main drive; and continued to use the plug-ins as is. That was the approach that let me get back to real work as quickly as possible.

Components

The components of this upgrade consisted of the hard-drive cartridges, the new hard disk, the controller, and several utility programs. The cartridges came from CyberGuys, distributor of all sorts of useful, interesting, and sometimes cute

computer accessories. The cover of their catalog says "Wholesale Catalog," but the company is happy to sell in small quantities to people like us. CyberGuys has great prices on slim-line cable adapters, printer stands, and all sorts of things. The company also has the lowest-price removable hard-drive system I've seen. For IDE, the fixed unit costs about \$18, and the cartridges about \$12. SCSI units are available at slightly higher prices. These are not the most rugged units I've seen; I wouldn't use them in a commercial airliner, for example. But for low-volume use in a "friendly" environment, they're fine.

For years, IDE lagged SCSI in performance by a considerable amount. Recently, however, the gap has been closing; competitive drives have been introduced by numerous manufacturers (though for overall performance, flexibility, expandability, and compatibility, SCSI remains king). I selected a 10-GB unit, part of the Deskstar GXP series made by IBM. And yes, you can actually have more than 8.4 GB in a single partition, as shown in Fig. 1.

Average seek time of the GXP series is rated at 9.5 ms, although I measured 7.7 ms. The big news is that rotation speed is 7200 rpm, and that translates into a big performance boost over the 5400 rpm units in common use today—theoretically, 33% better performance. Practical results come close to the ideal. For example, time to boot and log the test machine on the network improved about 30%.

Faster drives are available—10,000 rpm—but quite a bit more expensive. Currently, 7200 rpm hits the sweet spot on the price/performance curve.

Handling data at the increased DTR (Data Transfer Rate) requires an Ultra IDE interface. That in turn required a new controller. (Some newer motherboards have built-in Ultra IDE support; check your documentation to be sure.) I selected the Ultra33 made by Promise Technology. It is possible to run an Ultra IDE drive off a standard IDE interface, but performance will be limited to the maximum supported by that interface: 16.7 MB/sec vs. 33 MB/sec under Ultra IDE.

The Ultra33 is widely available for under \$70. Under DOS and Windows 3.1, the Ultra33's on-board BIOS provides full performance and access to drives greater than 8 GB. Under Win95, Win98, and NT, a driver is required. Driver updates are easily accessible from the company's Web site. The Ultra33 can function in addition to or instead of the on-board IDE controller, for a maximum of eight IDE devices (master and slave devices each on the primary and secondary channels of the motherboard and Ultra33 controllers). With no boot device connected to the motherboard controller, the Ultra33 can boot your system.

I've written here in the past about a program called PartitionMagic, from PowerQuest. The company also makes DriveImage, a special utility program used to clone disk partitions from one physical drive to another. In the simplest case, DriveImage can literally clone one drive to another, optionally resizing partitions along the way. You can also use the program to create and save a partition image as a regular disk file, and later "restore" that image to the same or

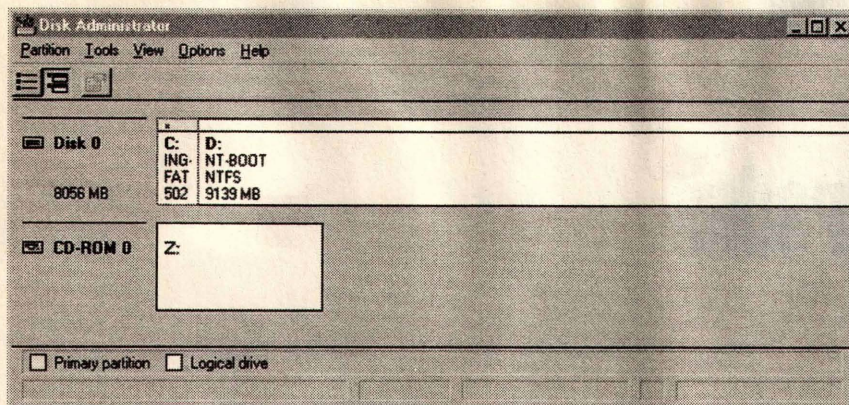


FIG. 1—YES, NINE GB IN A SINGLE PARTITION really is possible. The Promise Ultra33 provides a data-transfer rate up to 33 MB/sec, and has BIOS support for large drives under DOS and Windows.

LISTING 1-SAMPLE BOOT.INI

```
[boot loader]
timeout=4
default=multi(0)disk(0)rdisk(0)partition(2)\WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(2)\WINNT="Windows NT Workstation Version 4.00"
multi(0)disk(0)rdisk(0)partition(2)\WINNT="Windows NT Workstation Version 4.00
[VGA mode]" /basevideo /sos
C:\="MS-DOS"
```

another drive. DriveImage is powerful and easy to use. It costs about \$70 and can be purchased directly from the company's Web site.

I love DriveImage. However, \$70 is a bit steep for one-time use. In addition, the license allows use on only one machine. PowerQuest needs to revamp its pricing and license structures to correspond to the way the product is actually used. On the other hand, PowerQuest also sells a program called DriveCopy for about \$30 that only does disk-to-disk copying. DriveCopy is intended for one-time disk upgrades like that discussed here.

Before using DriveImage, I tried a program called Ghost, which performs a similar function, although it is primarily aimed at corporations wishing to clone large numbers of systems simultaneous-

ly over a network. Despite having heard good things about Ghost, I was unable to get it to work; it repeatedly crashed with various error messages. However, Symantec recently bought the company, so I would expect the bugs to be cleaned up and a better pricing and licensing scheme instituted. A "Pro" version of DriveImage competes more directly with Ghost.

The Process

The upgrade process involves installing the new controller and drive, cloning the old drive to the new, and then reconfiguring the system to boot from the new drive. The Initial hardware installation is simple: Insert the Ultra33 into an empty PCI slot, and connect the new hard drive to the primary channel of the new controller with a standard IDE

cable. At this point you should be able to see the drive using FDISK or the Disk Administrator under NT. Note: You don't need to create or format any partitions prior to using DriveImage; in fact, doing so would be a waste of time.

Under Win95, Win98, or NT, you need to install the driver before disabling the original drive. Otherwise you may not be able to boot, or you may not see the whole drive (i.e., anything over 8.4 GB).

Next, boot to DOS, and use DriveImage to clone the old drive to the new. Regardless of which operating system(s) you run, you must run DriveImage from DOS. With DriveImage, you can copy one or more partitions, optionally resizing any or all in the process. The program has a step-by-step Wizard-based interface; most options are explained well. It's quite easy to use; and if you change your mind or make a mistake, as long as you don't do anything to the original drive, you can always just start over.

The amount of time it takes depends on several factors, including the number of partitions being copied, the amount of data on each, and verification options set within DriveImage. I found I could clone well over 1 GB of data in about an hour.

The third step is to disable the on-board controller or remove the original drive. At that point you should be able to boot from the new drive. If you only boot from drive C—the first and primary (and possibly only) partition—and run any Microsoft OS other than NT, you should be in business. If you boot from another drive (under NT, OS/2, or some version of UNIX), you may have to tweak things to be able to boot. Let's look at what we are talking about in the case of NT.

Tweak for NT

While enabling and disabling the various hard drives, NT may get confused about where the boot partition is located. NT stores that information in a text file called BOOT.INI in the root directory

TABLE 1-DATA TRANSFER RATE COMPARISON

Drive	Controller	DTR (kb/s)	Average Seek Time (ms)
IBM 371010	Ultra33	28565	7.7
Seagate ST31277A	Ultra33	12925	10.4
Seagate ST31277A	Internal	7857	10.3
Western Digital Caviar AC21600H	Ultra33	1378	9.1
Western Digital Caviar AC21600H	Internal	8033	9.5
Quantum XP31070W	2940UW	16281	9.2
Fujitsu M2954S-512	2940UW	965	8.6
IBM 34560	2940UW	31605	7.9

FOR MORE INFORMATION

CyberGuys

Tel: 800-892-1010

Web: www.cyberguys.com

IBM

Web: www.ibm.com/harddisk

PowerQuest

Tel: 801-226-8977

Web: www.powerquest.com

Promise Technology

Tel: 408-452-1180

Web: www.promise.com

of drive C (the first physical partition of the first physical drive). When it boots, NT presents a menu of options, depending on which operating system(s) you had installed on the drive before installing NT. Typically, you might see options to boot DOS, NT in normal mode, and NT in VGA mode (which parallels the "safe" mode of Win95).

BOOT.INI normally has the hidden, read-only, and system attributes set, so to edit it you must issue a command like the following:

```
C:\>attrib -h -r -s boot.ini
```

When you're through, to be safe, return those attributes to their default states:

```
C:\>attrib +h +r +s boot.ini
```

Internally, BOOT.INI looks something like what's shown in Listing 1; depending on where, what, and how you boot, your mileage may vary. In the file, the values within parentheses specify the drive and partition where each bootable OS recognized by Windows resides. In particular, the value for partition(n) may change. I had to manually edit BOOT.INI several times to enable NT to boot (part of that involved installing a CD-ROM writer, which in turn changed drive lettering and partition assignments).

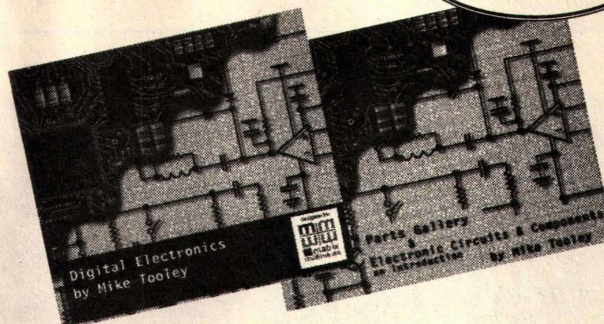
Another point is that the PowerQuest programs in general understand a lot about disk formats under DOS and all versions of Windows, and that includes the new FAT32 format native to Win98. They also seem to be pretty intelligent about NetWare, but I have no experience with that. Their understanding of UNIX is minimal, so although they can do sector-by-sector disk copies, most of their speed and robustness advantages are lost. So if you run Linux, BSD, or some other UNIX—beware.

(Continued on page 23)

ELECTRONICS CD ROMs

The most effective way of learning Digital Electronics

Complete Course
on CD ROM!
Only \$75⁰⁰



Digital Electronics builds on the knowledge of logic gates covered in Electronic Circuits and Components, and takes users through the subject of digital electronics up to the operation and architecture of microprocessors. The included virtual laboratories allow users to operate many circuits on screen.

Digital Fundamentals

Starting from the very basic principles of logic gate operation, Digital Electronics guides users through Boolean algebra, combinational and sequential logic to complex digital systems such as A/Ds and DACs, memories and microprocessors. Virtual Laboratories and worked examples help to build students' confidence and promote understanding.

Combinational Sequential Logic

Multiple gate circuits, equivalent logic functions, and specialised logic functions such as majority vote, parity checker, scrambler, half and full adders. Includes fully interactive virtual Laboratories for all circuits.

Sequential Logic, Digital Systems, and a Gallery of commonly used IC schematics are also included!

- Virtual Laboratories
- Worked Examples
- Full Audio Commentary

See and Test a demo version at <http://www.MatrixMultimedia.co.uk>

Claggk Inc., PO Box 4099
Farmingdale, NY 11735-0792
e-mail: claggk@poptronix.com



Name _____ Phone _____

Address _____

City _____ State _____ Zip _____

Enclosed is \$75 for each student version of *Digital Electronics* on a single CD ROM, shipping included inside the U.S. Shipping costs to Canada an additional \$3.00. Overseas orders please contact CLAGGK, Inc. for shipping costs.

I am ordering (....) copies at \$75 each. NY State residents must include sales tax.

☐ I have enclosed my check for \$ _____

☐ Please charge my credit card for \$ _____

☐ Visa ☐ MasterCard ☐ Discover Expiration Date ____/____/____

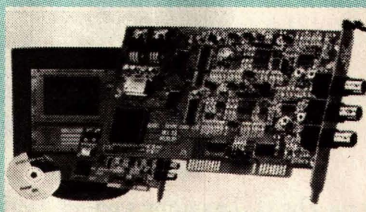


EQUIPMENT REPORT

PROTEK SCOPE CARD 220 PC-BASED OSCILLOSCOPE

*If you already have a PC,
you can also have a digital
storage oscilloscope for very little
money when you install this
versatile add-on card.*

CIRCLE 15 ON FREE INFORMATION CARD



As any regular reader of **Electronics Now** could tell you, an oscilloscope is one of the most important pieces of test gear one can have. That's why many readers of this magazine already own an oscilloscope. For those who don't, the chief reason is their high cost. Even a basic 10 or 20 MHz analog scope could easily run \$500.

Well, if you already own a personal computer, and most of you do, there is a less expensive alternative—the Protek Scope Card 220. Even better, what you'll have is not a simple analog unit, but a digital storage oscilloscope, or DSO. Among their advantages, DSOs can store information and waveforms for you, so taking down measurements with a pencil and pad is eliminated.

If you are worrying that you'll need to have the latest Pentium II powerhouse running Windows 98 or NT to use the Scope Card 220, don't. In fact, anything from a 486 on up will work just fine. So, if you have a long-since replaced 486 sitting in your closet, you can combine it with the Scope Card and get a great DSO for just \$230. You won't even need to buy scope probes, as the unit comes with two sets. Let's look at some details.

The Scope Card 220

The Scope Card 220 is a dual-channel, 20-megasample per second digital oscilloscope that takes the form of an ISA expansion card for any 486 and up PC. Software is provided for Windows 95 only, which should not be a problem for most. We

installed the card under Windows 98, and that went quite smoothly.

While most 486 or higher computers will do nicely, there are some minimum requirements that must be observed. The Scope Card 220 requires VGA graphics, and you'll probably want to have at least 16 megabytes of memory to run Windows 95, as required by the software. Ten megabytes of disk space is also needed.

The benefits of tying an oscilloscope to a personal computer are many. For example, captured waveforms are instantly stored in RAM and can even be logged to disk. What's more, a computer's processing power makes short work of plotting of data, with hard-copy readouts readily available from any Windows-compatible printer.

The Scope Card 220 comes with "virtual oscilloscope" software that places the test instrument readout and controls on-screen. That powerful software allows multiple boards to operate together. Simultaneous data acquisition from up to 16 channels with sampling rates up to 20 megasamples per second (20MS/s) is possible. Signals and system setups can be saved for future access. The 8-bit ISA card has two BNC scope inputs and an external trigger input.

Maximum input voltage is 300 volts, with auto setup for signals from 30Hz to 2MHz, 35V_{pp} maximum. Input protection is diode-clamped with input impedance at 1 megohm. The card can trigger off Channel 1, Channel 2, or the external

trigger input. Time per division can be set from 50ns/div. to 0.5s/div., with the display set for Channel 1, Channel 2, Dual, or Add. Volts per division can be set from 50mV/div. to 5V/div. An X-Y mode is provided, and the grid on the display can be turned on and off. The software allows placement of cursors on various parts of waveforms to provide accurate digital readouts of signal measurements. A Scroll mode display, which lets the unit function like a chart recorder, can be set in six ranges from 10 seconds up to an hour.

Limitations

The Scope Card 220 makes a great audio troubleshooting and analyzing tool, and it's especially well-suited for schools that already have PCs. It is also good for long-term data recording and analysis that's simple and affordable.

However, there are some limitations you should be aware of. The Scope Card 220's practical bandwidth is only 4 megahertz (MHz), or even just 2 MHz depending on how you look at it. With a maximum sampling rate of 20 MS/s, you end up with only 10 samples per cycle of a 2 MHz signal and only 5 samples (the bare minimum) at 4 MHz. So even though the unit technically is a DSO, you can't necessarily troubleshoot digital circuitry with it.

The worst thing about this product is its instructions, or lack thereof. Weak help comes in the form of poorly translated text files on the CD-ROM and related help files in the software. Nowhere does it even mention which of the BNC inputs is which. The documentation is also unnecessarily confusing so avoid using it.

That's not as much of a problem as it sounds. Anyone familiar with PCs will have no trouble installing the card and running the install software. It is also quite easy to get the card to work, and the virtual controls are intuitive to use for anyone that has already used an oscillo-

(Continued on page 23)

Prototype

Wearable Computer Helps Detectives Collect All The Evidence

Computers are playing an ever increasing role in law enforcement. One new application is to increase the efficiency and accuracy in collecting, identifying, tagging, and storing evidence at the scene of a crime. Researchers at the Department of Energy's Pacific Northwest National Laboratory working with Mnemonic Systems Inc. are developing the Team Leader. This is a portable computer system designed specifically for use in the field to prevent contaminating or compromising evidence during collection. This is critical because even a tiny slip-up can make the difference between a criminal being convicted or going free.

A Wearable Computer

The heart of the Team Leader is a Xybernaut Corporation *Mobile Assistant* "wearable" computer. The rugged, weatherproof, IBM-compatible personal computer is belt-worn. A tiny, head-worn display screen, attached microphone, and voice controller frees both hands to work with the evidence. The Team Leader has a variety of data collection tools with accompanying software. These include digital video and still cameras, voice recorder, bar-code scanner, and several specialized sensors. Data can also be entered manually using a small wrist-worn keyboard.

Team Leader's sophisticated capabilities include the ability to capture and use satellite images, terrain features, architectural drawings, site plans, and other information to precisely pinpoint the location of evidence as required for a thorough investigation. Useful here is the latest in geographical information systems (GIS) together with global positioning, multi-media computing, and communication technologies.

The Team Leader can also function as a portable crime library with access



HERE AN INVESTIGATOR WEARING THE TEAM LEADER computer on a waistband enters information on a wrist-worn keyboard. A small display screen and microphone is worn on the headband.

to volumes of stored or online information, such as maps; facility floor plans; crime and criminal databases; reports; forms; investigation protocols; and sci-

entific, technical and legal reference material. The user can also easily access off-site computers, printers, and fax machines.

At The Crime Scene

At complex crime scenes, up to eight Team Leaders could be operated by investigators who could exchange information and communicate simultaneously. The Team Leader can be used for voice and video conferencing.

As evidence is collected, each item can be digitized, "tagged" with an assigned bar code, and the data transferred immediately to an evidence custodian. Using the bar code, it could be recalled months or even years later such as during a trial. Acquired information is sent back to "headquarters" by fax, e-mail, or wireless local area network (LAN) lines.

As one example, detectives at a murder scene could use the Team Leader while tracking the route of the suspect to create a very precise and detailed map of the scene. If a murder weapon is discovered, investigators could link the evidence to its geographical position with laser measurements and positional data, take still and video pictures, and document detailed audio and text notes to record a complete story that could later be used in court.

Because of the variety of tools available and the on-line capability, one person can do the work of a whole team of investigators. Fewer people on the scene not only reduces the manpower required to complete an investigation, it also means less chance of inadvertent evidence contamination from fingerprints, footprints, hair, fiber, or other sources besides the person who committed the crime.

The Team Leader features a modular design so it can be easily customized for a variety of applications. For example, Pacific Northwest and Mnemonic, with guidance from the National Forensic Science Training Center, are customizing versions of the Team Leader for a



DR. DENNIS DEPPE AND DR. DIANA HUFFAKER and their team created a semiconductor laser using quantum-dot technology.

range of law-enforcement and forensic applications. The technology and hardware could be adapted for use in search and rescue, disaster recovery and relief, hazardous material cleanup, and fighting fires.

Another important aspect of the research is establishing the standards and criteria by which digital evidence is accepted by the U.S. criminal justice system. Here the researchers are working with the FBI, American Society of Crime Laboratory Directors, and others. They are also working with the law-enforcement and forensic communities to establish and equip Team Leader with specific directions or protocols for processing crime scenes. These protocols could set an industry standard.

After the Team Leader is field tested by police departments in Baltimore, Miami (Metro-Dade) and Los Angeles, Mnemonics will be marketing a commercial version of the product. This should occur by early 1999.—By Bill Siuru

PT

Low-Cost Lasers

Using a new technology known as "quantum dots," engineers at the Microelectronics Research Center at The University of Texas (UT) at Austin

have created a semiconductor laser. The quantum-dot technology allowed the engineers to use gallium arsenide to create the 1.3-micron laser wavelengths in high demand by industry.

Currently commercial lasers that work at 1.3 microns are made from iridium phosphide that is not only ten times more expensive, but also less heat tolerant. The 1.3-micron wavelength allows optical fibers in telephone lines to transmit much more information over long distances, and maintains truer sound and images in high-speed data applications such as the Internet.

"Because of the significant cost savings, the telecommunications industry has been pushing hard for a gallium arsenide laser that operates at this wavelength," said Dr. Dennis Deppe, associate professor of electrical and computer engineering.

Using quantum dots to create the lasers is a relatively new approach. Also known as "artificial atoms" because they have an electronic structure similar to natural atoms, the quantum dots are tiny clusters of semiconductor material that trap electrical charges. As the trapped charges lose their energy, they emit light, which can be used in high-speed lasers. Deppe, Dr. Diana Huffaker, and

FOR MORE INFORMATION

Pacific Northwest National Laboratory
PO Box 999
Richland, WA 99352
Web: www.pnl.gov

Xybernaut Corporation
12701 Fair Lakes Circle
Suite 550
Fairfax, VA 22033
Web: www.xybernaut.com

Mnemonic Systems Incorporated
2001 L Street, N.W., Suite 1000
Washington, DC 20036

their research team found that by engineering the quantum dots, which are 20,000 times smaller than the diameter of a human hair, they could increase the laser wavelengths of gallium arsenide to record levels.

Incorporating the same technology last year, Deppe's group collaborated with Dr. Joe Campbell, a UT professor of electrical engineering, to use quantum dots to create the detector for this type of laser. "To bring fiber interconnects to businesses, homes and computers, we needed inexpensive, gallium arsenide lasers that until recently did not exist at this wavelength, and until now did not perform well," said Deppe. "With both the laser emitter and detector demonstrated in the laboratory, the technology can become a reality. An especially important application to obtain low cost will be the Vertical Cavity Surface Emitting Laser, or VCSEL, a device that is very difficult to make using iridium-phosphide technology."

Bar code scanners, digital video discs, and read/write CDs also use VCSELs. Because of the longer wavelength, a variation of the quantum-dot laser technology can also become important when future computer chips use light instead of wires to transmit information from chip-to-chip, noted Deppe. The laser is estimated to be at least two years from commercial production. **PT**

Chaos-Based Computing Paradigm

A revolutionary computing technique uses a network of chaotic elements to "evolve" its answers. This "dynamics-based computation" may be well suited for optical computing. "This is a glimpse of how we can make common dynamic systems work for us in a way that's more like how we think the brain does computation. It's an entirely new computing paradigm," stated Dr. William L. Ditto, professor of physics at the Georgia Institute of Technology.

The system has so far demonstrated an ability to handle a wide range of common operations, including addition and multiplication, as well as Boolean logic and more sophisticated operations such as finding the least common multiplier in a sequence of integers.

Ditto and collaborator Sudeshna Sinha of the Institute of Mathematical Sciences in Madras, India devised an experiment to see if a simple network of chaotic computer elements could be made to handle computations. They joined the chaotic elements into a lattice using an adaptive connecting mechanism that would open whenever an element exceeded a certain critical value. The mechanism was designed so that the researchers could set a wide range of critical values to vary the connection between elements.

Using a variety of different techniques, the researchers encoded values into the chaotic lattice. They then stimulated the elements to begin interacting. Elements containing values above the critical level triggered the connecting mechanism, allowing the excess value to "avalanche" into neighboring elements, which led to additional avalanches in other connected elements. With additional stimulation, the domino effect continued until the imbalance was conducted out of the system—as the answer to the mathematical problem.

For example, values of three and four would be encoded into a system set with a critical value of one. The values would create an imbalance that would avalanche through the chaotic elements until it was conducted out of the system—as the value of seven.

Chaotic elements are useful to this system because they can assume an infinite number of behaviors that can be used to represent different values or different systems, such as logic gates. This flexibility allows a single generic system to perform a variety of computations. In conventional computing, systems are more specialized.

"We are not really setting up rules in the same sense that digital computers are programmed," Ditto explained. "We...let the dynamics do the work of finding a pattern that performs the desired operation."

"There are a surprisingly large number of ways that the system can perform the computations and give you the answer," he added. "By slightly changing the connectivity and the parameters of the chaotic system, we can have it multiply several different ways through the system's self organization. It might be better than digital computing for activities that digital computing doesn't do

very well—such as pattern recognition or detecting the difference between two pieces of music."

Ditto believes the new system would work particularly well in optical systems. "Potentially, we could simulate a very fast system of coupled lasers to perform a highly complicated operation like very fast arithmetic operations, pattern detection, and Fourier transforms," he explained. "We have something that very naturally performs an operation in an optical system. This would provide an alternative to existing efforts, which try to make optical systems do operations more like transistors."

A number of engineering issues may hamper development of a practical system based on this computing paradigm. But Ditto notes that in their early days, digital computers had to overcome daunting obstacles to overtake earlier techniques. **PT**

Biosensor Bacteria

Bacteria that eat pollutants have been adapted to create live bacterial biosensors that detect and signal the presence of phenol pollution. Phenols are a family of harsh pollutants widespread in the manufacture of dyes, photographic chemicals, wood preservatives, and pesticides.

The reporter bacteria are modified so that instead of making digesting enzymes when they contact complex phenols, a protein in the bacteria produces an easy-to-observe and -measure signal. These biosensors can indicate the presence of eight of the priority pollutant phenols listed by the Environmental Protection Agency. Further research may lead to the design of proteins to detect other chemicals. **PT**

World's Smallest Hard-Disk Drive

IBM recently unveiled the world's smallest and lightest hard-disk drive with a disk platter about the size of a large coin. Although IBM's new microdrive weighs less than an AA battery, it can hold over 200 times more data or images than a floppy disk.

With its small size and high-performance, the microdrive can bring high-

capacity storage to almost any handheld digital device. It is ideally suited for use in companion PCs, GPS navigation systems, cellular phones, and still and digital video cameras. Digital photographers can now take more photos before having to download the stored images. They can also take higher resolution "megapixel" photos more economically.

Microdrive fits into a CompactFlash Type II slot, an increasingly popular standard that has already been built into handheld devices made by companies such as Canon, Inc. Microdrive can be used with a standard PC card adapter if a device does not have this slot.

Unlike other portable storage formats such as flash memory, microdrive uses hard-disk-drive technology to store information. Compared with similarly sized flash memory cards, the 340-MB microdrive device has a much lower cost per MB.

IBM's microdrive will allow for data to be shared among different handheld devices, for example, a notebook computer, digital camera, and printer. Or a companion PC user could easily carry additional data and software programs on a business trip with the vast amount of storage offered by microdrive.

Microdrive is expected to stimulate the invention of new devices. Since the advance hard-drive technology is so

small, it could fit almost anywhere—even in a wristwatch-sized device for storing phone numbers or schedules.

It will be available in mid-1999 on retailer shelves or directly from IBM. Further technical and application information can be found at IBM's hard-drive Web site: www.ibm.com/storage/microdrive **PT**

Refrozen Food Detector

If frozen food thawed while being transported cross-country, was then refrozen, and you bought it, how would you know the food wasn't fit to eat? Perhaps by a color change in an inexpensive thaw indicator placed in the package.

The indicator, originated and patented at Sandia, changes color when its temperature rises above 32 degrees F. The color doesn't change back if the temperature then drops below freezing, says Sandia researcher David Martinez.

The invention, a byproduct of a solar research project, depends upon an inexpensive "smart" material—a thin wire that "remembers" multiple shapes and acts as a sensor. Using no power source except warming or cooling, the wire changes shape markedly and powerfully at appropriate temperatures. When warmed, movement of the wire tears a colored green paper to reveal the red color underneath. When cooled, the wire returns to its prior position but because the paper is torn, the warning color remains visible.

Martinez and co-developer Mo Shahinpoor of the University of New Mexico have developed eight preliminary designs, all patented, in which a smart-material sensor exposes a color-coded paper. The wire actuators utilize nitinol, a smart material consisting of nickel and titanium.

Manufactured by the thousands or millions, the crucial elements in the design—a wire about the size of a piece of thread less than 3/8-inches long—would cost "pennies for the raw materials," says Martinez. "When there's pressure from Washington on food processors, transporters, and displayers to protect consumers against spoiled food, we have a technology patented to do just that." **PT**

LCDs + UV = Innovation

Recently, the development of an innovative process that promises to greatly increase production yields of Liquid Crystal Displays (LCDs) was announced by The MicroDisplay Corp. This form of non-contact alignment uses UV light directed from a laser, which could revolutionize the production of both standard and miniature LCDs.

Traditional LCDs are basically large glass sandwiches, filled with liquid crystal. Microdisplays replace one of the glass "slices" with silicon. The industry standard LCD manufacturing process for liquid crystal alignment uses velvet cloth, which causes the greatest yield loss due to high probabilities of contamination, mechanical damage, or damage due to electrostatic discharge.

Experiments have been conducted in recent years to replace the mechanical rubbing process with non-contact alignment, sometimes called UV rubbing. MicroDisplay's non-contact alignment process replaces the velvet with a precisely controlled laser beam of UV light. This alignment process works by subjecting the panes to holographic exposure: directing two coherent beams of UV light at the panes of the display. Because the panes were coated with a chemical that reacts very predictably to the carefully regulated laser light, this exposure produces the alignment of liquid crystal material required by LCDs.

According to Xiaodong Wang, Senior Research Engineer at the MicroDisplay Corp., "Non-contact alignment is particularly significant in the production of miniature displays. For example, because the pixels of a miniature display are so small, one speck of dust can ruin more than one pixel. By removing the rubbing cloth from the process, non-contact alignment promises to virtually eliminate the occurrence of these contaminants by keeping the displays in a sterile environment throughout production." The MicroDisplay Corp. has filed a patent to cover this innovative UV rubbing process. Experiments are currently under way to prove the viability of the process in the production of both standard and miniature LCDs. **PT**



WITH A DISK PLATTER ABOUT THE SIZE of a large coin, IBM's new microdrive can hold over 200 times more data or images than a floppy disk.

Plug a Friend into
Electronics
NOW[®]
and Save \$41.89*

This Christmas give an electrifying gift ... plug a friend into Electronics Now and brighten the whole new year! Whether electronics is your friend's livelihood or hobby, your gift will illuminate the whole spectrum of electronics throughout the coming year and provide a monthly reminder of your friendship.

Electronics Now will keep your friend informed and up-to-date with new ideas and innovations in all areas of electronics technology ... computers, video, radio, stereo, solid-state devices, satellite TV, medical electronics, communications, robotics, and much, much more.

We'll provide great plans and printed circuit patterns for great electronic projects. In just the last few years, Electronics Now has presented amateur TV equipment, robots, computer peripherals, microcontroller programmers, test equipment, audio amplifiers, telephone projects, relay circuits, and much more.

PLUS ... equipment troubleshooting techniques ... circuit design ... reports on new technology and products ... equipment test reports ... in-depth coverage on computers, video, audio, vintage radio ... and lots more exciting features and articles.

SAVE \$41.89* ... OR EVEN \$83.78* ... For each gift of Electronics Now you give this Christmas, you save a full \$41.89* off the newsstand price. And as a gift donor, you're entitled to start or extend your own subscription at the same Special Holiday Gift Rate—you save an additional \$41.89*!

No need to send money ... if you prefer, we'll hold the bill till January, 1999. But you must rush the attached Gift Certificate to us to allow time to process your order and send a handsome gift announcement card, signed with your name, in time for Christmas.

So do it now ... take just a moment to fill in the names of a friend or two and mail the Gift Certificate to us in its attached, postage-paid reply envelope. That's all it takes to plug your friends into a whole year of exciting projects and new ideas in Electronics Now!

*Basic sub rate — 1 yr/\$24.99 2 yrs/\$48.99

Monitor Safety, CRTs, and Adjustments

THIS MONTH WE WILL CONTINUE OUR DISCUSSION OF COMPUTER AND VIDEO MONITORS. FIRST OFF, WE'LL COVER THE EXTREMELY IMPORTANT SAFETY INFORMATION AND WARNINGS. WHILE YOU HAVE PROBABLY SEEN A SET OF GUIDELINES

similar to these in our series on microwave oven repair, it never hurts to repeat them. Then, we'll move on to CRT basics, degaussing, and monitor adjustments.

Safety

TVs and computer or video monitors are among the more dangerous of consumer electronics equipment when it comes to servicing. In case you are wondering, microwave ovens are probably the most hazardous due to high voltage at flesh frying and cardiac arresting high power. There are two areas that have particularly nasty electrical dangers: the non-isolated line power supply and the CRT high voltage.

Major parts of nearly all modern TVs and many computer monitors are directly connected to the AC line—there is no power transformer to provide a safety barrier and/or to minimize the risk of equipment damage. In the majority of designs, the live parts of the TV or monitor are limited to the AC input and line filter, degauss circuit, bridge rectifier and main filter capacitor(s), low voltage (B+) regulator (if any), horizontal output transistor and primary side of the flyback (LOPT) transformer, and parts of the startup circuit and standby power supply. The flyback generates most of the other voltages used in the unit and provides an isolation barrier so that the signal circuits are not line connected and safer. Higher quality monitors use a separate switch-

mode power-supply, limiting non-isolated circuitry to the supply's input (the deflection/flyback runs off isolated DC).

The high voltage to the CRT, while 200 times greater than the line input, is not nearly as dangerous for several reasons. First, it is present in a very limited area of the TV or monitor—from the output of the flyback to the CRT anode via the fat HV wire and suction cup connector. If you don't need to remove the main board or replace the flyback or CRT, then leave it alone and it should not bite you. Furthermore, while the shock from the HV can be quite painful due to the capacitance of the CRT envelope, it is not nearly as likely to be lethal since the current available from the line-connected power supply is much greater.

Safety Guidelines

These guidelines are to protect you from potentially deadly electrical shock hazards as well as to protect the equipment from accidental damage. Note that the danger to you is not only in your body providing a conducting path, particularly through your heart, but that any involuntary muscle contractions caused by a shock, while perhaps harmless in itself, might cause collateral damage—there are many sharp edges inside this type of equipment as well as other electrically live parts you may contact accidentally.

The purpose of this set of guidelines

is not to frighten you but rather to make you aware of the appropriate precautions. Repair of TVs, monitors, microwave ovens, and other consumer and industrial equipment can be both rewarding and economical. Just be sure that it is also safe! With that in mind, here we go:

- Don't work alone—in the event of an emergency another person's presence may be essential.
- Always keep one hand in your pocket when anywhere around a powered line-connected or high voltage system.
- Wear rubber bottom shoes or sneakers.
- Don't wear any jewelry or other articles that could accidentally contact circuitry and conduct current or get caught in moving parts.
- Set up your work area away from possible grounds that you might accidentally contact.
- Know your equipment: TVs and monitors may use parts of the metal chassis as ground return yet the chassis may be electrically live with respect to the earth ground of the AC line. Microwave ovens use the chassis as ground return for the high voltage. In addition, do not assume that the chassis is a suitable ground for your test equipment!
- If circuit boards need to be removed from their mountings, put insulating material between the boards and anything they may short to. Hold them in place with string or electrical tape. Prop them up with insulation sticks—plastic or wood.
- If you need to probe, solder, or otherwise touch circuits with power off, discharge the large power-supply filter capacitors. If you are removing the high

voltage connection to the CRT (to replace the flyback transformer, for example) first discharge the CRT contact (under the suction cup at the end of the fat HV wire). See below for more details on these procedures.

- For TVs and monitors in particular, there is the additional danger of CRT implosion—take care not to bang the CRT envelope with your tools. An implosion will scatter shards of glass at high velocity in every direction—there are several tons of force attempting to crush the typical CRT. While implosion is not really likely even with modest abuse, why take chances? However, the CRT neck is relatively thin and fragile, and breaking it would be very embarrassing and costly. Always wear eye protection when working around the back side of a CRT.

- Connect/disconnect any test leads with the equipment unpowered and unplugged. Use clip leads or solder temporary wires to reach cramped locations or difficult to reach locations.

- If you must probe live circuits, put electrical tape over all but the last $1/16$ -inch of the test probes to avoid the possibility of an accidental short that could cause damage to various components. Clip the reference end of the meter or scope to the appropriate ground return so that you need to only probe with one hand.

- Perform as many tests as possible with power off and the equipment unplugged. For example, the semiconductors in the power supply section of a TV or monitor can be tested for short circuits with an ohmmeter.

- Use an isolation transformer if there is any chance of contacting line connected circuits. A Variac is not an isolation transformer! The use of a GFCI (Ground Fault Circuit Interrupter) protected outlet is a good idea, but it will not protect you from shock from many points in a line-connected TV or monitor, or the high-voltage side of a microwave oven, for example. A fuse or circuit breaker is too slow and insensitive to provide any protection for you or, in many cases, your equipment.

- Don't attempt repair work when you are tired. Not only will you be more careless, but your primary diagnostic tool—deductive reasoning—will not be operating at full capacity.

- Finally, never assume anything without checking it out for yourself! Don't take shortcuts!

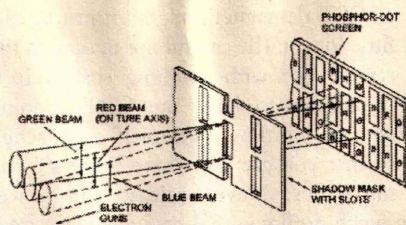


FIG. 1—COLOR CRTs USED IN VIDEO monitors and TV sets have a shadow mask or aperture grill located a fraction of an inch behind the phosphor screen to direct the electron beams for the red, green, and blue video signals to the proper phosphor dots.

Dealing with Capacitors

It is essential—for your safety and to prevent damage to the device under test as well as your test equipment—that large or high voltage capacitors be fully discharged before measurements are made, soldering is attempted, or the circuitry is touched in any way. Some of the large filter capacitors commonly found in line-operated equipment store a potentially lethal charge.

This doesn't mean that every one of the 250 capacitors needs to be discharged every time you power off and want to make a measurement. However, the large, main filter capacitors and other capacitors in the power supplies should be checked and discharged if any significant voltage is found after powering off (or before any testing—the CRT capacitance in a TV or video monitor, for example, can retain a dangerous or at least painful charge for days or longer!)

Use a suitable power resistor rather than a screwdriver to do the dirty work. Why? There are three reasons: 1) It will not destroy screwdrivers and capacitor terminals; 2) it will not damage the capacitor (due to the current pulse); and 3) it will reduce your spouse's stress level in not having to hear those scary snaps and crackles.

As far as values, for the main capacitors in a TV or monitor power supply, which might be 400 μ F at 200V, use a 5000-ohm, 10W resistor. For the CRT, use a several megohm resistor rated at 30KV or more (or a string of lower value resistors to obtain this voltage rating). A $1/4$ -watt unit will just arc over! Discharge to the chassis ground connected to the outside of the CRT—not signal ground on the main board as you could damage sensitive circuitry. The discharge time needed is short—a millisecond or so. However, repeat a few times to be sure,

then use a shorting clip as these capacitors have a way of recovering a painful charge if left alone.

Finally, when discharging capacitors, it is obviously vital to make sure that you are well insulated. And always double check that the capacitor has indeed been discharged before beginning your work.

Tools, Test Equipment, Troubleshooting Tips

These topics were covered in depth in numerous previous "Service Clinic" columns. If you do not have your back issues of **Electronics Now**, you can find the information at my Web site (www.repairfaq.org). Look for the document titled "Troubleshooting and Repair of Consumer Electronics Equipment."

Color CRTs

All color CRTs use a shadow mask or aperture grill located a fraction of an inch ($1/2$ -inch typical) behind the phosphor screen to direct the electron beams for the red, green, and blue video signals to the proper phosphor dots (see Fig. 1). Since the electron beams for the R, G, and B phosphors originate from slightly different positions (individual electron guns for each) and thus arrive at slightly different angles, only the proper phosphors are excited when the purity is properly adjusted and the necessary magnetic field free region is maintained inside the CRT.

The shadow mask consists of a thin steel or InVar (a ferrous alloy) sheet with a fine array of holes—one for each trio of phosphor dots—positioned about $1/2$ -inch behind the surface of the phosphor screen. With some CRTs, the phosphors are arranged in triangular formations called triads with each of the color dots at the apex of the triangle. With many TVs and some monitors, they are arranged as vertical slots with the phosphors for the 3 colors next to one another.

An aperture grille, used exclusively in Sony Trinitrons (and now their clones as well), replaces the shadow mask with an array of finely tensioned vertical wires. Along with other characteristics of the aperture grille approach, this permits a somewhat higher possible brightness to be achieved and is more immune to other problems like line-induced *moiré* and purity changes due to local heating causing distortion of the shadow mask.

However, disadvantages include a heavy structure, higher price, a cylindrical screen (though this may be considered

an advantage depending on your preference), and 1, 2, or 3 fine horizontal stabilizing wires (depending on screen size) which may be objectionable or unacceptable for certain applications.

Degaussing

Degaussing might be required if there are color purity problems with the display. On rare occasions, there might be geometric distortion caused by magnetic fields, but no associated color problems. The CRT can become magnetized if the TV or monitor is moved or even just rotated, there has been a lightning strike nearby, a permanent magnet was brought near the screen (e.g., kid's magnet or megawatt stereo speakers), or some piece of electrical or electronic equipment with unshielded magnetic fields is in the vicinity of the TV or monitor.

Degaussing should be the first thing attempted whenever color purity problems are detected. First try the internal degauss circuits of the TV or monitor (always present though they could be faulty) by power cycling a few times (on for a minute, off for 20 minutes, on for a minute, etc.). If this does not help or does not completely cure the problem, then you can try manually degaussing.

Commercial CRT Degaussers are available from parts distributors like MCM Electronics and consist of a hundred or so turns of magnet wire in a 6- to 12-inch coil. They include a line cord and a switch. You flip on the switch, and bring the coil to within several inches of the screen face. Then you slowly draw the center of the coil toward one edge of the screen and trace the perimeter of the screen face. Then return to the original position (with the coil being flat against the center of the screen). Next, slowly decrease the field to zero by backing straight up across the room as you hold the coil. When you are farther than 5 feet away, you can release the line switch.

The key word here is *slow*. Go too fast and you will freeze the instantaneous intensity of the 50/60 Hz AC magnetic field variation into the ferrous components of the CRT, and could make the problem worse.

It looks really cool to do this while the CRT is powered. The kids will love the color effects (but then lock your degaussing coil safely away so they don't try it on every TV and monitor in the house!).

Bulk tape erasers, tape-head degaussers, open-frame transformers, and the tail-end of a soldering gun can be used

as CRT demagnetizers, but it just takes a little longer. (Be careful not to scratch the screen face with anything sharp.) It is imperative to have the CRT running when using those "wimpier" approaches, so that you can see where there are still impurities. Never release the power switch until you're 4 or 5 feet away from the screen or you'll have to start over.

Keep degaussing fields away from magnetic media. It is a good idea to avoid degaussing in a room with floppies or back-up tapes. When removing media from a room, remember to check desk drawers and manuals for stray floppies, too.

Preventive Maintenance

Preventive maintenance for a monitor is pretty simple—just keep the case clean and free of obstructions. Clean the CRT screen with a soft cloth just dampened with water and mild detergent or isopropyl alcohol. This will avoid damage to normal as well as antireflection coated glass. DO NOT use anything so wet that liquid may seep inside of the monitor around the edge of the CRT. You could end up with a very expensive repair bill when the liquid decides to short out the main circuit board lurking just below.

In really dusty situations, periodically vacuuming inside the case and the use of contact cleaner for the controls might be a good idea, but realistically you will not do this so don't worry about it.

Getting Inside

Before we continue, it is important to note that by removing the rear cover of a monitor you will void the warranty—at least in principle. There are usually no warranty seals on a monitor, so unless you cause visible damage or mangle the screws or plastic, it is unlikely that this would be detected, but the decision to go ahead is yours to make. Of course, a monitor still under warranty should probably be returned for warranty service for any covered problems except those with the most obvious and easy solutions. Another advantage of using warranty service is that should your problem actually be covered by a design change, a related repair will be performed free of charge, and, you cannot generally fix a problem that is due to poor design!

Opening up a monitor is usually quite simple, requiring only the removal of 2 to 10 Philips or 1/2-inch hex head screws; these will mostly be around the edge of the cabinet, though some could be

underneath and perhaps in the rear. Set the screws aside and make notes if they are not all of the same length and thread type—putting a too-long screw in the wrong place can short out a circuit board or break something else.

Once all visible screws are out, try to remove the cover. There still may be hidden catches or snaps around the edges or seams, or hidden beneath little plastic or rubber cosmetic covers. Sometimes, the tilt-swivel base will need to be removed first.

As you pull the cover straight back (usually) and off, make sure that no other wires are still attached. Often, the main circuit board rests on the bottom of the cover in some slots. Go slow as this circuit board may try to come away with the back. Once the back is off, you may need to prop the circuit board up with a block of wood to prevent stress damage and contact with the work surface.

Once the cover is removed, most—but not all—monitors can be safely rested either on a still-attached tilt-swivel base or on the bottom of the frame. However, some will require care as the circuit board will be vulnerable.

Larger monitors are quite heavy and bulky. Get someone to help, and take precautions if yours is unstable when the cover is removed. If need be, the monitor can usually safely be positioned on the CRT face if it is protected by foam or a folded blanket.

Once the cover is off, you'll see something resembling what is shown in Fig. 2. One thing you'll find is anywhere from none to a frustratingly large number of perforated and/or solid sheet-metal shields. Depending on which circuit boards need to be accessed, one or more of those shields may need to be removed. Make notes of which screws go where and store them in a safe place. However, manufacturers often place holes at strategic locations in order to access adjustments—check for these before going to a lot of unnecessary bother. Note: sheet metal usually has sharp edges. Take care.

Monitor Adjustments

In the next sections we'll discuss the use of the controls accessible to the user (and often not understood) as well as internal adjustments that may need to be touched up due to the aging of components or following a repair. There's a lot to do, so let's get to it.

User Picture Adjustment

For general viewing, subdued lighting is preferred. Avoid backlighting and direct overhead lighting if possible.

Display an image with a variety of colors and the full range of brightness from deep shadows to strong highlights. For PCs, a Windows desktop is generally satisfactory. An outdoor scene on a sunny day is excellent for studio monitors. Alternatively, use a test pattern specially designed for this purpose.

Turn the brightness and contrast controls (or use the buttons) all the way down. Increase the brightness until a raster is just visible in the darkest (shadow) areas of the picture and then back off until it just disappears. Increase the contrast until the desired intensity of highlights is obtained. Since the brightness and contrast are not always independent, go back and forth between the adjustments until you get the best picture.

Focus Adjustment

One of the most common complaints is that the monitor is not as crisp as it used to be—or just not as sharp as expected. Assuming that the focus has just been gradually getting worse over time, tweaking the internal focus control may be all that is needed to correct this.

Some monitors have the focus adjustment accessible through a (possibly unmarked) hole in the side or rear of the case. If there is a single hole, it is almost certainly for overall focus. If there are two holes, one may be the screen (G2—master brightness) or the two adjustments may be for different aspects of focus.

Better monitors will have H and V focus controls. There may be both static (more-or-less uniform in all areas of the screen) as well as dynamic focus (compensates for changing distance to electron guns at the edges and corners of the screen). The most sophisticated schemes use a microprocessor (or at least digital logic) to specify the waveform for each section of the screen with a map of correction values stored in non-volatile memory. You might need a custom adapter cable and PC software to adjust values for these!

Brightness and Color Balance

A monitor that has a picture that is too dark or too bright and cannot be adequately set with the user brightness and contrast controls could need internal adjustment of the screen (the term,

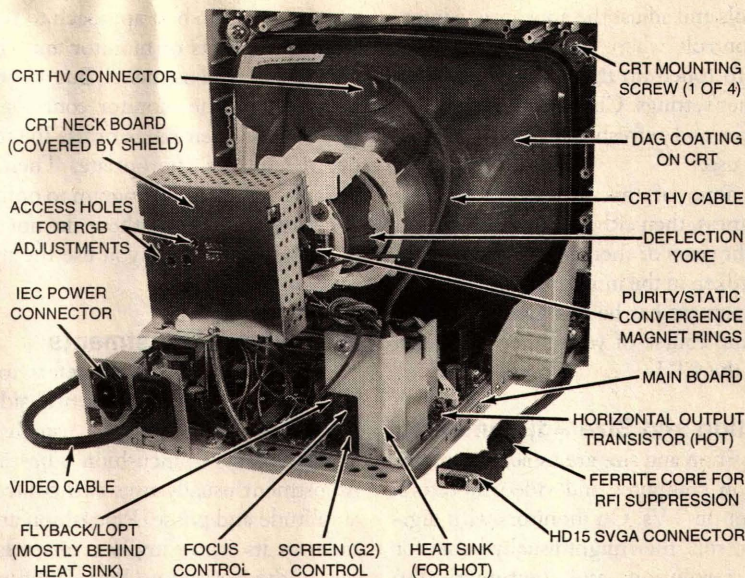


FIG. 2—HERE'S A LOOK INSIDE a typical computer monitor. The key adjustments, boards, and other items you'll find in most units are identified.

screen, here refers to a particular electrode inside the CRT, not really the brightness of the screen you see, though it applies here), master-brightness, or background-level controls. As components age, including the CRT, the brightness will change, usually decreasing. The following procedure will not rejuvenate an old CRT but may get just enough brightness back to provide useful functionality for a few months or longer. If the problem is not caused by the age of the CRT, then it may return the monitor to full brightness.

The controls might be located on the flyback transformer, CRT neck board, or main board. In some cases, they are accessible without removing the cover.

Display a black and white picture at the video resolution you consider most important. Select one that has both full blacks and full whites—a nice sunny outdoor scene that has been converted from a color image, for example. Set the user brightness control to its midpoint and the user contrast control as low as it will go—counterclockwise.

Let the monitor warm up for at least 15 minutes so that components can stabilize. If there is a master-brightness or background-level control, use it to make the black areas of the picture just barely disappear. Then, increase it until the raster lines just appear. (They should be a neutral gray. If there is a color tint present, then the individual color background controls will need to be adjusted to obtain a neutral gray.) If there is no such control, use the master screen con-

trol on the flyback (usually the bottom potentiometer).

If there are individual controls for each color, you may use them, but be careful as you will be affecting the color balance. Adjust so that the raster lines in a black area are just visible and are a dark neutral gray.

Now for the gain controls: On the little board on the neck of the CRT or on the video or main board, there will be controls for R, G, and B drive (also may be called gain or contrast—they are the same). The knobs or slots may even be color coded as to which primary (R,G,B) it affects. If there are only two, then the third color is fixed and if the color balance in the highlights of the picture was OK, then there is nothing more you can do here.

Set the user contrast control as high as it will go—clockwise. Now adjust each internal color drive control as high as you can without that particular color “blooming” at very bright vertical edges. You may need to go back and forth among the three drive controls, since the color that blooms first will limit the amount that you can increase the contrast settings. Set them so that you get the brightest neutral whites possible without any single color blooming.

Note that this is ignoring the effects of any beam current or brightness limiter circuitry. Any recommendations in the service manual should be followed to minimize the chance of excess X-ray emissions, as well as to avoid burn-in of the phosphor screen.

Now check out the range of the user

controls and adjust the appropriate internal controls where necessary. You may need to touch up the background levels or other settings. Check at the other resolutions and refresh rates that you normally use.

If none of this provides acceptable brightness, then either your CRT is in its twilight years or there is something actually broken in the monitor. If the decrease in brightness has been a gradual process over the course of years, then it is most likely the CRT.

Position and Size Adjustments

Position and size are usually user controls on computer and video monitors, but not on TVs. On monitors with digital controls, they might usually be set for each resolution and (automatically) stored in non-volatile memory so they will be retained when the monitor is turned off. On cheaper monitors, there may be knobs on the front or back panel that might need to be readjusted whenever the scan rate/resolution is changed. Sometimes, the adjustments are located internally. There may be separate adjustments for each scan range, and those may or may not be accessible through holes in the back panel.

There might also be an adjustment called horizontal phase, which controls the relative timing of the horizontal-sync pulse with respect to retrace. Its effect is subtly different than horizontal position, which actually moves the raster. If possible, center the raster and then use horizontal phase control to center the picture.

Size can be set to your preference for each scan rate (if they are independent). For computer work, slight underscan is often preferred as all of the frame buffer is visible. However, any slight geometric problems with the raster will be all too visible when compared with the straight sides of the CRT bezel.

Note that resolutions like 640×480 , 800×600 , and 1024×768 all have a 4:3 aspect ratio. The edge of the image will line up with the bezel on most if not all monitors, since CRTs are made to a 4:3 aspect ratio. However, resolutions like 1280×1024 and 1600×1280 have a 5:4 aspect ratio. With those, in order to get (highly desirable) square pixels, the horizontal size must be adjusted slightly smaller than that required to fill the screen.

Of course, parameters controlling your video card also affect position and

size. There is no best approach to reconciling the effects of monitor and video-card position adjustments. But, in general, start with the monitor controls centered within their range or use the memory defaults as appropriate. Then, use the video card setup program to optimize the settings. Only if these do not have enough range should you use the monitor controls.

Pincushion Adjustments

Horizontal pincushion refers to any bowing in or out on the vertical sides of the raster. There is not usually any explicit vertical pincushion adjustment. Adjustment usually uses two controls—amplitude and phase. Pincushion amplitude, as its name implies, controls the size of the correction. Pincushion phase affects where on the sides it is applied. Don't expect perfection.

If the controls have no effect, there is probably a fault in the pincushion correction circuitry. It is best to make these adjustments with a crosshatch or dot test pattern

CRT Purity and Convergence

Purity assures that each of the beams for the three primary colors—R, G, B (red, green, and blue)—strikes only the proper phosphor for that color. A totally red scene will appear pure red and so forth. Symptoms of poor purity are blotches of discoloration on the screen. Objects will change shades of color when they move from one part of the screen to another. There may even be excess non-uniformity of pure white or gray images.

Convergence refers to the control of the instantaneous positions of the red, green, and blue spots as they scan across the face of the CRT so that they are as nearly coincident as possible. Symptoms of poor convergence are colored borders on solid objects or visible separate R, G, and B images of fine lines or images,

The first thing to do here is to cycle power on and off a couple of times to degauss the CRT (1 minute on, 20 minutes off). If the built in degaussing circuits have no effect, use an external manual degaussing coil to be sure that your problems are not simply due to residual magnetism. For more on degaussing, see the appropriate section earlier in this column.

Space does not permit us to cover the detailed procedures for purity and convergence adjustments here. More details

are provided at my Web site (www.repairfaq.org), but my general recommendation would be to leave it alone unless these problems are severe—it is very easy to make things worse.

Tilted Picture

You have just noticed that the picture on your monitor is not quite horizontal—not aligned with the front bezel. You also might notice some keystoneing or other geometric distortion as well, where the top and bottom (or left and right) edges of the picture are not quite parallel—it might have always been there; you just never have noticed it until now. There are several possible causes for a tilted picture:

- **Monitor Orientation:** The horizontal component of the earth's magnetic field affects this slightly. Therefore, if you rotate the unit you may be able to correct the tilt. Of course, best results could occur when the monitor faces the wall! Also, other external magnetic fields can sometimes cause a rotation without any other obvious effects—have you changed the monitor's location? Did an MRI scanner move in next door?

- **Need for Degaussing:** Most of the time, magnetization of the CRT will result in color problems that will be far more obvious than a slight rotation—but not always.

- **The Problem Has Always Existed:** That means, of course, that nothing has changed: Don't dismiss this offhand. It is amazing how much we ignore unless it is brought to our attention. Are you a perfectionist? Did your friend just visit boasting about his cutting-edge screamer and point the tilt out to you?

- **Misadjusted tilt control.**

- **Deflection Yoke Orientation:** The deflection yoke was somehow rotated, or perhaps it was not oriented correctly at the time of the set's manufacture.

- **CRT Position:** The CRT might have rotated slightly with respect to the front bezel.

Wrap Up

That's all we have space for this month. Next month we will begin discussing actual troubleshooting, starting with low-voltage power supply problems. Until then, check out my Web site, www.repairfaq.org. I welcome comments (via e-mail at sam@stdavids.picker.com) of all types and will reply promptly to requests for information. See you next time!



LETTERS

SEND YOUR COMMENTS TO THE EDITORS OF ELECTRONICS NOW MAGAZINE

"Möbius Circuit" Revisited

When I read the article, "Möbius Circuit" (*Electronics Now*, October 1998), it brought back some childhood memories of a "Magic Trick" that I learned. As I read it through, something seemed incorrect and not as I remembered. I had to try it to refresh my memory.

The article correctly states that cutting around a paper loop with a half twist in it will result in a loop twice the circumference of the original with a full twist in it. It then erroneously goes on to say that cutting around the resulting loop will result in a loop with four times the circumference of the original with more twist in it. The author obviously has not tried this, or he would have found that the result of the second cut would be two loops of the same circumference as the loop resulting from the first cut. These two loops are intertwined and could not be separated except by tearing one of them.

Nonetheless, the article was interest-

ing and informative.

ROBERT F. BLUM
Huntington Station, NY

NOPPP Updates

Here are some further updates for NOPPP, the "No Parts" PIC Programmer featured in the September 1998 issue. First, the NOPPP software, available from the NOPPP Web page (www.mindspring.com/~covington/noppp), now includes a test mode so you can use a voltmeter to make sure your programmer is wired correctly.

Write To:
Letters,
Electronics Now Magazine,
500 Bi-County Blvd.,
Farmingdale, NY 11735

Due to the volume of mail we receive, not all letters can be answered personally. All letters are subject to editing for clarity and length.

Second, we've heard that some readers have had some problems getting NOPPP to work correctly. Here are some tips that could help:

1. Make sure to tie together all the ground pins (18, 19, 20, 21, 22, 23, 24, and 25) where the parallel port cable connects to the NOPPP circuit; grounding through just one pin may not be enough to prevent crosstalk and glitches.

2. Use a short cable between NOPPP and PC (less than two feet). Some parallel ports will drive a longer cable cleanly; some won't.

3. In a few cases, it may be necessary to replace the 1N914 diodes with germanium diodes (1N34A or equivalent), or even Schottky diodes, to get better logic levels.

Finally, arrangements are being made to market NOPPP as a kit, which will be available from Ramsey Electronics (793 Canning Parkway, Victor, NY 14564; Web: www.ramsey-electronics.com).

MICHAEL A. COVINGTON

EN

COMPUTER CONNECTIONS

continued from page 11

Results

Table 1 shows overall data transfer rate for several drives of several types connected to various controllers. First I compared performance of several IDE drives connected to both the Ultra33 and the on-board controller. Both the Western Digital and the Seagate drives posted roughly 50% better performance on the Ultra33. For comparison, I also tested several SCSI drives running on an Adaptec 2940UW controller. The IBM SCSI drive was the clear performance leader, followed by the IBM IDE drive.

Operationally, the upgrade produced a noticeable speed improvement, not to mention a greatly augmented space for installing the ever-expanding development tools from Inprise (Borland), Microsoft, Sun, and others. With so much space, I'm looking at some CD-

emulation software that allows you to create images of CD-ROMs and access them much faster and more conveniently directly from the hard drive. More later; until then you can stay in touch by writing me at jeff@ingeninc.com.

EN

EQUIPMENT REPORTS

continued from page 12

scope. One thing that could hang you up is the fact that two separate install programs must be run: one for the card's Normal mode and another for the Scroll mode. But now that you know about that—thanks to this review!—that should no longer be a problem.

Most installations will involve just a single card, and a jumper block that sets the card's address can be left in the factory-default setting. We found that Windows 98 did not detect the card, but the card worked right after installing the software. If you want to install more than one Scope Card 220, you have to set a unique

address for each card you install. Though you won't find a PC with eight free expansion slots, in theory the software allows up to eight cards to work at once.

Not state of the art by any means, the Scope Card 220 is still a very useful troubleshooting tool and learning aid. It also provides functionality that many expensive high-bandwidth oscilloscopes just don't, such as the ability to log data directly to hard disk. If you have an old 486 hidden away somewhere and have been wondering what to do with it, the Scope Card 220 could be the ticket to pulling the computer out of retirement. Otherwise the Scope Card can live unobtrusively in your everyday working PC, coming out to help you troubleshoot circuitry once business is over and hobby time begins.

For more information on the Protek Scope Card 220, contact the manufacturer (Protek, 154 Veterans Drive, Northvale, NJ 07647; Tel: 201-767-7242; Web: www.hcprotek.com) directly, or circle 15 on the Free Information Card. EN

RETAILERS THAT SELL OUR MAGAZINE EVERY MONTH

California

California Electronics
221 N. Johnson Ave.
El Cajon, CA 90202

Ford Electronics
8431 Commonwealth Ave
Buena Park, CA 90621

All Electronics
14928 Oxnard Street
Van Nuys, CA 91411

Gateway Electronics of CA
9222 Chesapeake Drive
San Diego, CA 92123

Mac's Electronics
191 South "E" Street
San Bernardino, CA 92401

Electronics Warehouse
2691 Main Street
Riverside, CA 92501

Orvac Electronics
1645 E Orangethorpe Ave.
Fullerton, CA 92631

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove, CA 92643

JK Electronics
6395 Westminster Blvd.
Westminster, CA 92683

Kandarian Electronics
1101 19th Street
Bakersfield, CA 93301

Whitcomm Electronics
105 W. Dakota #106
Clovis, CA 93612

Minuteman Electronics
37111 Post St., Suite 1
Fremont, CA 94536

HCS Electronics
6819 S. Redwood Drive
Cotati, CA 94931

Halted Specialties Co.
3500 Ryder Street
Santa Clara, CA 95051

Metro Electronics
1831 J Street
Sacramento, CA 95814

HSC Electronics
4837 Amber Lane
Sacramento, CA 95841

Colorado

Gateway Electronics of CO
2525 Federal Blvd.
Denver, CO 80211

Centennial Electronics
2324 E. Bijou
Colorado Sps., CO 80909

Connecticut

Cables & Connectors
2198 Berlin Turnpike
Newington, CT 06111

Electronic Service Prod.
437 Washington Avenue
North Haven, CT 06473

Florida

P. Benavides Corp.
3900 NW 79 Ave. Suite 600
Miami, FL 33166

Georgia

Normans Electronics Inc.
3653 Clairmont Road
Chamblee, GA 30341

Illinois

Tri State Elex
200 W. Northwest Hwy.
Mt. Prospect, IL 60056

Maryland

Mark Elec. Supply Inc.
5015 Herzel Place
Beltsville, MD 20705

Amateur Radio Center
1117 West 36th Street
Baltimore, MD 21211

Massachusetts

U-Do-It Electronics
40 Franklin Street
Needham, MA 02194

Michigan

Purchase Radio Supply
327 East Hoover Avenue
Ann Arbor, MI 48104

Norwest Electronics
33760 Plymouth Rd.
Livonia, MI 48150

The Elec. Connection
37387 Ford Road
Westland, MI 48185

Elec. Parts Specialists
711 Kelso Street
Flint, MI 48506

Minnesota

Acme Electronics
224 Washington Avenue N.
Minneapolis, MN 55401

Missouri

Gateway Electronics of MO
8123-25 Page Blvd.
St. Louis, MO 63130

New Jersey

Lashen Electronics Inc.
21 Broadway
Denville, NJ 07834

New York

LNL Distributing Corp.
235 Robbins Lane
Syosset, NY 11791

Unicorn Electronics
Valley Plaza
Johnson City, NY 13790

Ohio

Philcap Electronic Suppliers
275 E. Market Street
Akron, OH 44308

Oregon

Norvac Electronics
7940 SW Nimbus Avenue
Beaverton, OR 97005

Texas

Tanner Electronics
1301 W Beltline
Carrollton, TX 75006

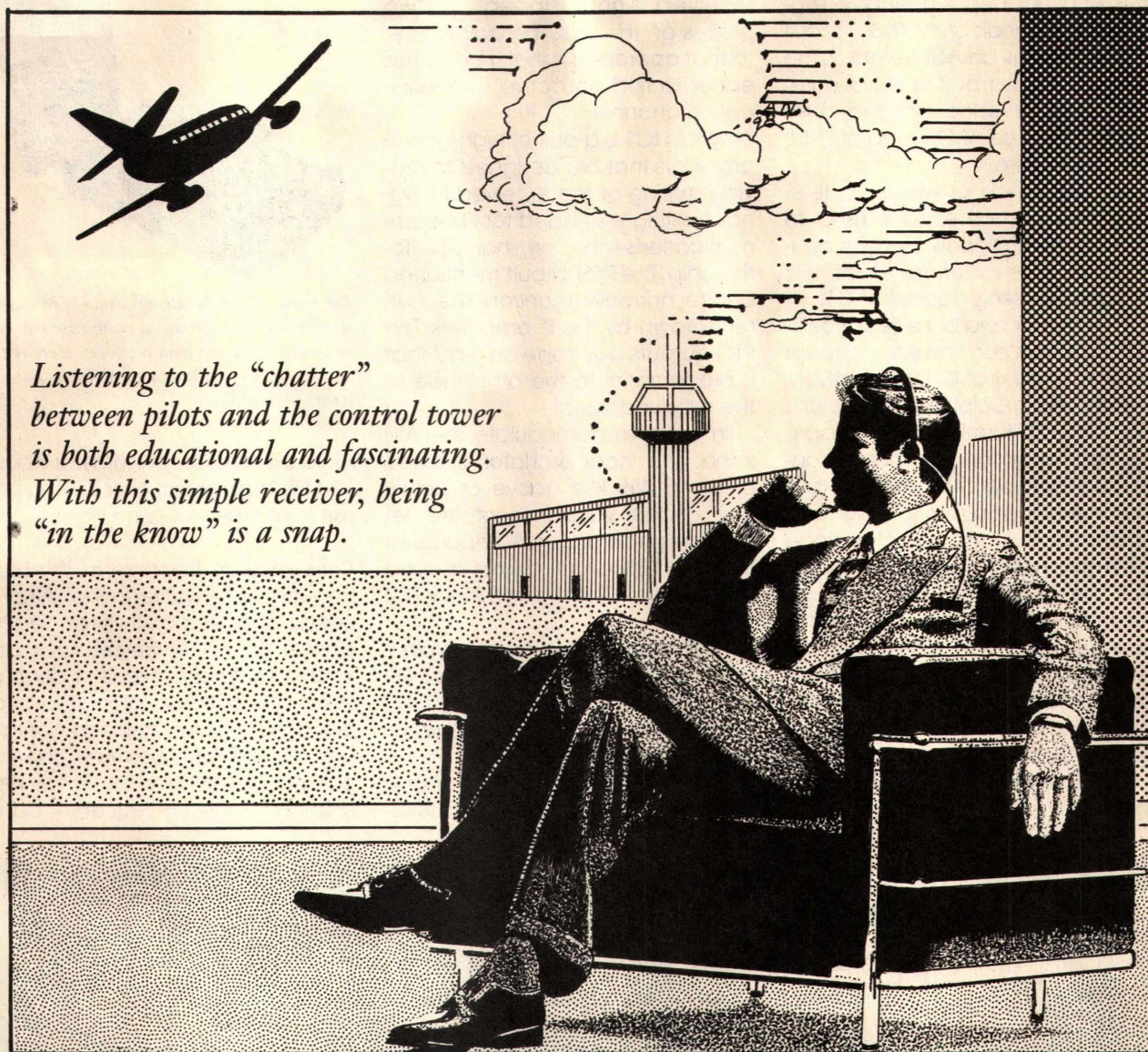
Mouser Electronics
958 N. Main Street
Mansfield, TX 76063

Electronic Parts Outlet
3753 B Fondren
Houston, TX 77063

Computers Electronics Etc.
110 E. Medical Center Blvd.
Webster, TX 77598

**If you'd like to sell our magazine in your store,
please circle 210 on free information card
or
Contact Gina Gallo at (516) 293-3000 ext 223**

THE AIRPORT BUDDY



Listening to the "chatter" between pilots and the control tower is both educational and fascinating. With this simple receiver, being "in the know" is a snap.

If you find yourself spending a lot of time at airports waiting for an outgoing or incoming flight, or if you have an interest in aviation in general, you've probably wondered about the type of communication that occurs between the pilots and the tower. Being "on the inside" has always fascinated people. If you want to be "in the know" in terms of aviation operations, then the Airport Buddy is a must-build project. This low-cost receiver will let you eavesdrop on communications between the control tower and aircraft flying above, and you will be able to keep up with what's going on. Even if you don't have that type

ANTHONY J. CARISTI

of interest in aviation radio, the Airport Buddy will make a unique gift for a friend or relative who does fly frequently.

The Airport Buddy is a one-chip VHF superheterodyne receiver that is easy to build, compact, and small enough to fit into a pocket. It is designed to receive audio communications in the 108- to 135-MHz frequency band, which is used for ground-to-air communications.

The project consists of a small PC board that is powered by a common 9-volt battery and fits in a small case. A pair of headphones is used

to hear the received audio signals. A knob-adjustable frequency control (either a single- or a multi-turn type) is used to tune in whatever conversations are taking place at the time. An optional volume control is easily added to the circuit.

Since all of the difficult design requirements of the circuit have been taken care of by a suitable PC board layout, a receiver that works well is easily built simply by following the construction details given here.

How It Works. The schematic diagram for the Airport Buddy is shown in Fig. 1. The heart of the receiver is IC1, a sophisticated IF (intermediate

frequency) amplifier chip that contains a mixer, a local-oscillator transistor, and a pair of high-gain IF amplifiers. Also included is a received-signal-strength indicator (RSSI) circuit that is used as an AM detector. The chip also has a built-in FM-quadrature detector; since air-traffic communications use AM instead of FM, it is not used here.

A short piece of wire or a telescoping radio antenna is used to pick up the RF signals. The RF is coupled to the mixer input of IC1 through coupling capacitor C1.

The emitter and base of the built-in local-oscillator transistor appear at pins 3 and 4 of IC1, respectively. The circuit is a Colpitts oscillator, with C3 and C4 forming the voltage-divider capacitor pair that is connected between the ground and the internal transistor's base and emitter. Coil L1 and varactor diode D2 form a parallel-tuned circuit that sets the local-oscillator frequency. Potentiometer R6 is a front-panel tuning control that adjusts the DC bias on D2. That sets the local-oscillator frequency for tuning the radio; it can be varied over the range of about 108 to 135 MHz.

The intermediate frequency of the circuit, 455 kHz, is set by RES1

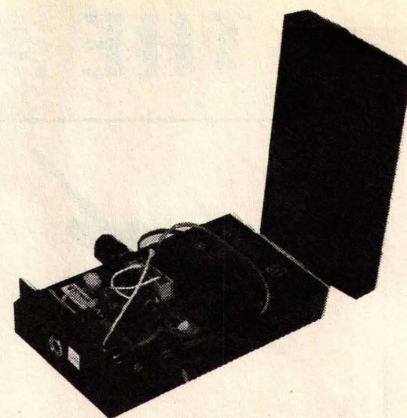
and RES2. An interesting feature of the Airport Buddy is the lack of RF preselection. That feature lets a received signal appear in two places on the dial. The advantage to that approach is that it becomes easier to find an active communication channel.

Within IC1 is a pair of high-gain IF amplifiers that are designed to provide limiting of the received RF signal. Limiting is needed for FM communications—the original use for the chip. The RSSI circuit mentioned before normally monitors the current drawn by the IF amplifiers. The RSSI outputs a voltage on pin 7 that is proportional to the amplitude of the received signal.

In order to demodulate the AM signal, the local oscillator is tuned either to 455 kHz above or below one of the sidebands of the received signal frequency. Because of that, the RSSI circuit makes a good demodulator for the received AM signals.

The demodulated audio on pin 7 of IC1 is coupled to the gate of Q1 through C8. The amplified signal is then coupled to an external headset through T1.

Power to operate the circuit is provided by a common 9-volt transistor-



The small size of the Airport Buddy's PC board lets the entire unit fit into a small case that can be easily carried in a shirt pocket. Here is the author's prototype. Note that ANT1 is simply a length of insulated wire.

radio battery. Current draw is about 10 milliamps, giving over 35 hours of use from a new alkaline battery.

Construction. Because of the high frequencies involved, the Airport Buddy should be built on a PC board. When RF frequencies are involved with any circuit, a double-sided board with a large solid-copper ground plane helps to contain any stray RF radiation from the circuit. Any circuit trace that is carrying a signal in the RF-frequency band

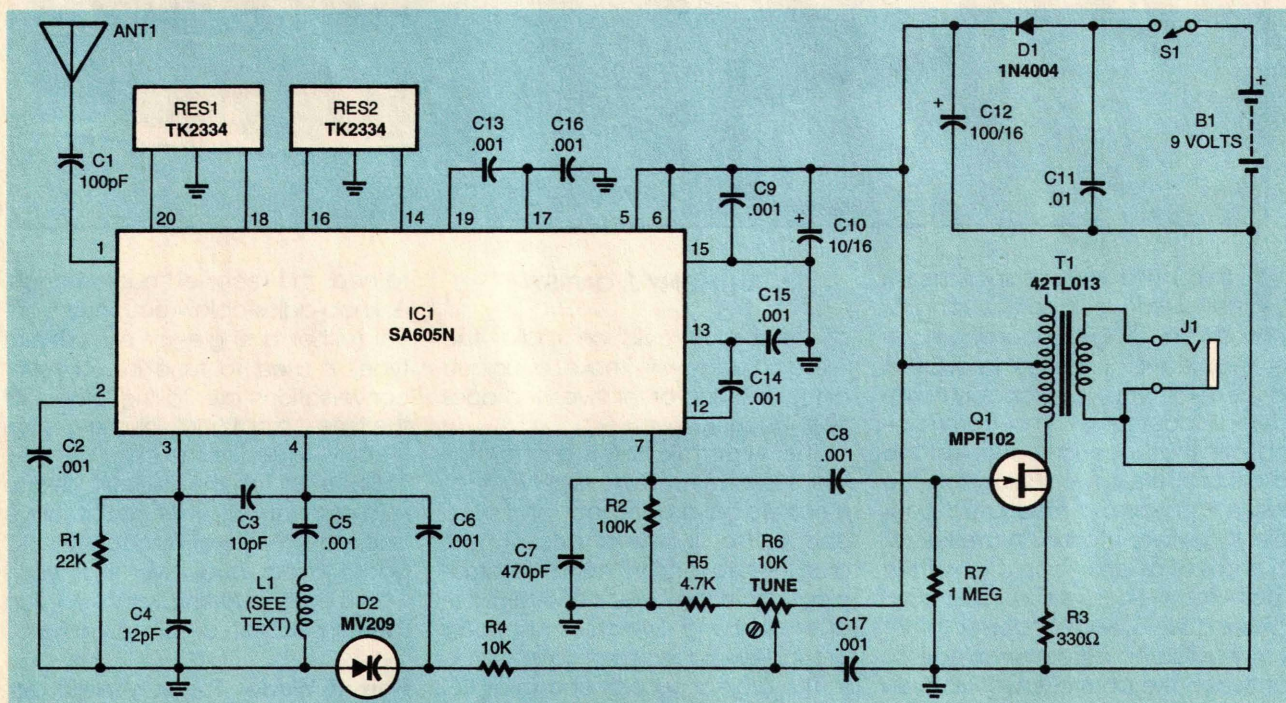


Fig. 1. The Airport Buddy is a simple receiver that is tuned to pick up frequencies used by aircraft. Although IC1 was originally designed to be used in an FM radio, it does a superb job with the AM-style method used by aircraft and airports.

TABLE 1
COMPONENTS GROUNDED
TO GROUND PLANE

R1	C11
R2	C15
R3	C16
R5	C17
C2	IC1 pin 15
C4	D2
C7	L1

can act like a miniature broadcast antenna, resulting in the disruption of any other receivers that happen to be close enough to the source of the RF leakage.

Foil patterns for the Airport Buddy have been included. If you do not wish to fabricate your own board, one may be obtained from the source given in the Parts List. If you are going to etch your own board, note that only one foil pattern is needed. That pattern is for the solder side of the board—the component side is left as a single ground plane. An easy way to etch the board is to coat the ground-plane side with resist; common shellac can be used. The other "foil pattern" only shows the locations of the holes that should be cleared of copper ground plane before building the circuit. Use a sharp knife to clear a small amount of copper from around the indicated holes. The component leads that will be inserted into those holes should not touch the ground plane. The other holes that will not be cleared will be used as ground connections on the top side of the board.

The parts-placement diagram shown in Fig. 2 is to be used for locating the various components if you are using a purchased board or one made from the foil pattern. Be sure to double-check the orientation of the polarized components. For example, D2 has an unusual package—it looks like a two-leaded transistor. Note, however, that RES1 and RES2 are *not* polarized. Do not install IC1 or C9 at this time.

Because of the high frequencies involved, keep the lead lengths as short as possible. Before installing T1, use an ohmmeter to measure the resistance of each of the windings. One winding, the primary, will

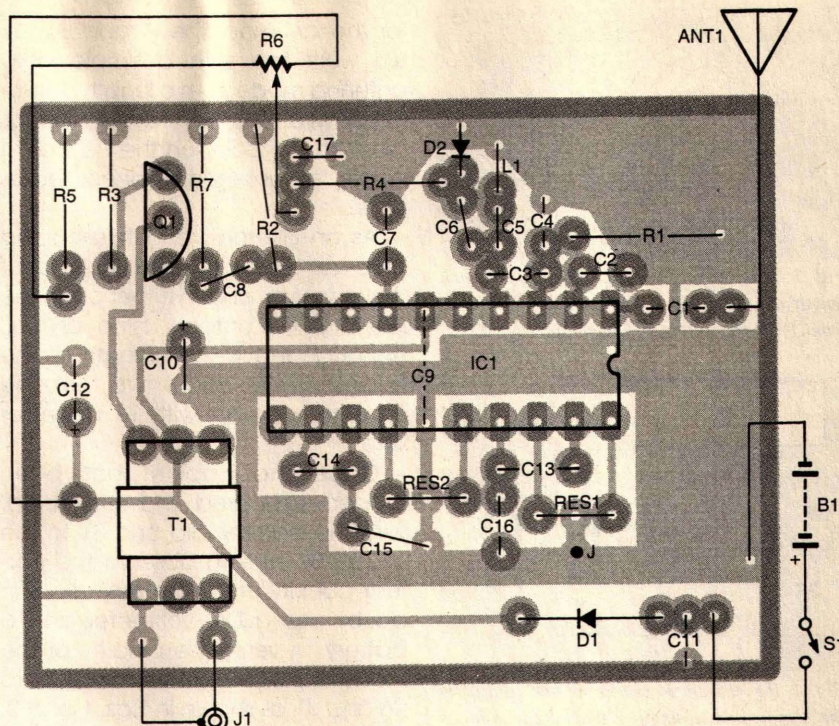


Fig. 2. Here's the parts-placement diagram for the Airport Buddy. Note that C9 is tack-soldered to the solder side of the board between the pins of IC1. Keep the body of C9 flat to the board.

measure about 50 ohms; the secondary will measure about 1 ohm. Mark the windings with a "P" and an "S" to be sure that the transformer is inserted properly into the circuit. The primary of the transformer is driven by Q1; the secondary feeds the earphone jack.

Coil L1 will be made from a piece of solid wire wrapped around a form. Following the dimensions shown in Fig. 3, wrap 3½ closely-spaced turns of insulated 22- or 24-gauge wire around an 1/8-inch-diameter form such as a drill bit. Following the height dimension shown in Fig. 3, insert the coil into the board and solder it in place. The coil can also be made from bare wire; however, the turns should not short out to each other or to the ground plane.

Table 1 lists the components that must have ground connections to the ground plane on the topside of the board as well as the bottom. Additionally, one through-hole wire is used to connect the ground plane to circuit ground; it is located next to RES1.

Once those components have been installed, use an ohmmeter to check the connections of all of the ungrounded components to be

sure that there are no short circuits to ground. Carefully examine all of the solder joints—they should be shiny and smooth. Correct any problems now before proceeding.

Check that all of the holes for IC1 on the topside of the board are clear of copper except for pin 15. When IC1 is inserted, none of those

TABLE 2
NORMAL VOLTAGES ON IC1

Pin No.	Voltage
1	1.4
2	1.4
3	5.4
4	6.2
5	6.3
6	6.3
7	0.25*
8	2.1
9	2.1
10	3.7
11	1.7
12	1.7
13	1.7
14	1.7
15	0 (gnd)
16	1.7
17	1.7
18	1.7
19	1.7
20	5.1

* The voltage on pin 7 depends upon signal strength.

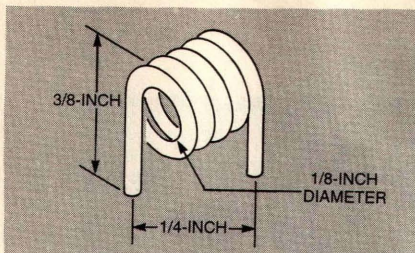


Fig. 3. It is easy to wind L1. Take a 3/8-inch length of 22- or 24-gauge insulated wire and wind 3 1/2 turns around a 1/8-inch-diameter drill.

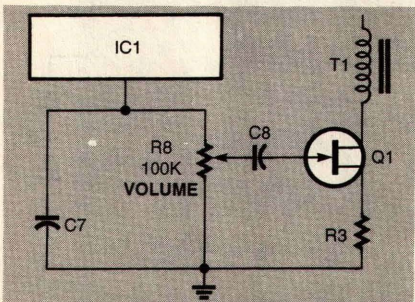


Fig. 4. If you want to add a volume control to the Airport Buddy, simply replace R2 with R8 as shown here. Lift the lead of C8 that would normally be connected to R2 and C7 and connect it instead to the wiper of R8.

pins should be touching the ground plane. Integrated circuits usually have pins designed to sit on top of the hole. If everything looks good, install and solder IC1 into the circuit. Be sure to solder pin 15 on both sides of the board.

Once IC1 has been soldered in place, turn the board over to the solder side. Capacitor C9 is tack-soldered underneath IC1 between pins 6 and 15. The leads of C9 must be cut as short as possible, and the body of the capacitor should lay as flat as possible against the board.

Any small case that can hold the PC board, a 9-volt battery, and the controls will work well. For example, a small case with a built-in battery compartment that fits easily into a shirt pocket can be used. Drill appropriate holes for J1, S1, and R6. You can use a single-turn potentiometer for R6 and draw a dial on the case, but it will be a bit more difficult to tune the Airport Buddy to a particular frequency than if you were to use a multi-turn potentiometer.

An option to consider is that of a volume control. If you want to use that option, which is detailed in Fig. 4, R8 must also be mounted in the case.

An additional hole will be needed

for the antenna. The Airport Buddy will work fine with a simple whip antenna made from a length of insulated wire. The hole should be as close to the point on the PC board where the antenna is connected as possible.

As an alternative, a telescoping antenna can be used instead of the length of wire. In either case, the length of the antenna is not critical. Although the 1/4-wavelength at the frequencies is about two feet, the receiver will work with 16 inches of wire.

Once the cabinet has been properly prepared and assembled, wire the battery clip and S1 to the circuit. Be sure to observe the correct polarity of the battery clip. If in doubt, use a DC voltmeter and a battery to verify the polarity of the leads. Make the final connections to R6 and J1 as shown in Figs. 1 and 2. Be sure to wire R6 so that clockwise rotation causes the voltage at its wiper to increase. That will give higher received frequencies with clockwise rotation of the knob. If you are going to use a stereo jack for J1, you should connect both left and right together on the jack.

Checkout Procedure. Before connecting B1 to the clip, check all of the wiring thoroughly once more to be sure that it is 100% correct. It is far easier to correct any problems or mistakes now rather than later if you find that the Airport Buddy does not work. Using an ohmmeter, measure the resistance across C12 to verify that there is no short circuit to ground on the main power line. Turn S1 off and clip a fresh alkaline 9-volt battery to the battery connector. Insert a headphone set into the jack. The Airport Buddy will work with any stereo or monaural headphones. However, the volume of the audio is directly proportional to the quality of the headset. Very low-cost headphones are relatively inefficient and will not produce as much volume as higher-quality units. Good headsets are readily available for less than \$20.00.

Turn S1 on. You should be able to hear a very soft "white noise" or static as the tuning knob is rotated over its range. If there are any aircraft nearby, you might hear voice

PARTS LIST FOR THE AIRPORT BUDDY

SEMICONDUCTORS

IC1—SA605N intermediate-frequency decoder/demodulator, integrated circuit
D1—1N4004 silicon diode
D2—MV209 varactor diode
Q1—MPF102 field-effect transistor

RESISTORS

(All resistors are 1/4-watt, 5% units, unless otherwise noted.)

R1—22,000-ohm
R2—100,000-ohm
R3—330-ohm
R4—10,000-ohm
R5—4700-ohm
R6—10,000-ohm, linear-taper potentiometer, panel mount
R7—1-megohm
R8—100,000-ohm linear- or audio-taper potentiometer, panel mount (optional volume control, see text)

CAPACITORS

C1—100-pF, ceramic-disc
C2, C5, C6, C8, C9, C13—C17—0.001-μF, ceramic-disc
C3—10-pF, NPO ceramic-disc
C4—12-pF, NPO ceramic-disc
C7—470-pF, ceramic-disc
C10—10-μF, 16-WVDC, electrolytic
C11—0.01-μF, ceramic-disc
C12—100-μF, 16-WVDC, electrolytic, low-leakage

ADDITIONAL PARTS AND MATERIALS

ANT1—Whip antenna, 16–24 inches (see text)
B1—9-volt transistor radio alkaline battery
J1—Earphone jack (stereo or monaural as needed)
RES1, RES2—455-kHz ceramic filter, Digi-Key TK2334
S1—Single-pole, single-throw, toggle or slide switch
T1—1000-ohm to 8-ohm audio transformer (Mouser 42TL013 or similar)
Enclosure (PacTek K-HM-9VB or similar), panel-mount adapter for R6, 9-volt battery clip, tuning knob, headset, hardware, etc.

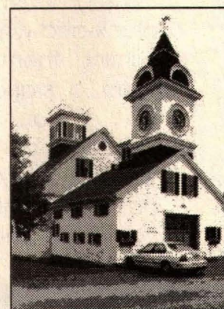
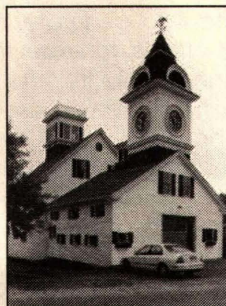
Note: The following items are available from: A. Caristi, 69 White Pond Road, Waldwick, NJ 07463; Etched and drilled PC board, \$15.75; IC1, \$12.50; D2, \$3.00. Please add \$5.00 for postage and handling. NJ residents add 6% sales tax.

communications.

If the receiver is working correctly, you can take your Airport Buddy to an airport and verify that you are able to listen in on aircraft communications. Otherwise, refer to the

(Continued on page 44)

THE VIDEO PALETTE II: A Low-Cost Video-Effects Device



Often in home-video work, some type of special effects would be useful to "liven up" an otherwise dull scene or create a more professional transition between scenes. That, unfortunately, usually means some expensive equipment that costs more than a thousand dollars. You could try using a fast multimedia PC—video-input hardware and huge hard drives are becoming the norm. Hardware is only half of the equation—expensive software packages would then be needed to manipulate the video data along with the time and discipline to learn how to use it. That is often out of the question for a home-video hobbyist on a limited budget. What is needed is a box of some kind that is able to produce a few special effects. It should be low cost and shouldn't need a college course and hours of practice to learn how to use.

Fascinated by video effects but can't afford the equipment or time to learn how to use it?

Now you can create some basic special effects with this low-cost unit.

**WILLIAM SHEETS, K2MQJ
AND RUDOLF F. GRAF, KA2CWL**

The Video Palette II is just what a budding video artist is looking for. It works with a single video source and is a stand-alone device that can do several video effects such as:

- Input amplification
- Video inversion (negative image)
- Posterization ("Cartoon" effects)
- Solarization
- Fadeout to black, gray, or white
- Contrast reduction
- Fade between normal and effects with mix
- Any of those effects in combination

A number of years ago, the authors published an article de-

scribing such a device. The original Video Palette worked well but was somewhat complex, had two PC boards that needed a lot of interconnecting wiring and needed an oscilloscope to set up. Advances in electronics have resulted in a new design. While based on the older system, it is much simpler to build, uses only one PC board, has fewer controls, has an added fade feature, and only needs four simple setup adjustments. No oscilloscope is required, unless you are curious and want to experiment.

A large-scale integration (LSI) sync-separator and sync-generator chip eliminates all of the timing adjustments that the original design had, as well as any drift. It is as close to "plug and play" as an analog circuit of this type can be. Wiring has been greatly simplified by the use of DC-controlled signal switching and by having all of the controls mounted on the PC board. With one

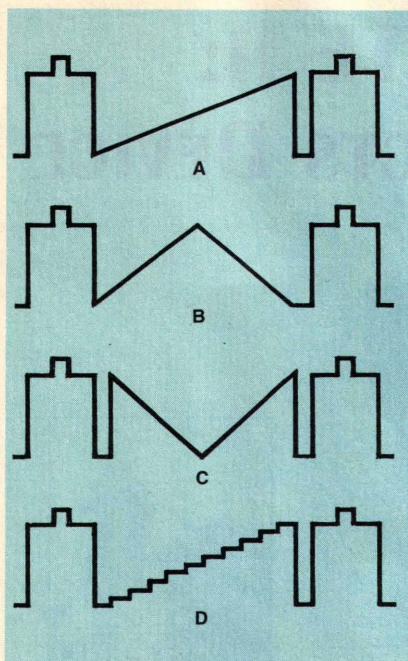


Fig. 1. The difference between solarization and posterization is in how the video waveform is modified. When a normal video signal (A) is solarized, darker hues are brightened at a much greater rate; and the lighter hues are darkened (B). A variation of solarizing is inverse solarizing (C). Posterizing (D) "digitizes" the signal into several discrete steps.

exception (a DPDT bypass switch), all of the mechanical switches are SPST types that either switch a single lead to ground or control AC power. The entire system can be built for around \$100 depending on how you package the unit and what parts you have on hand.

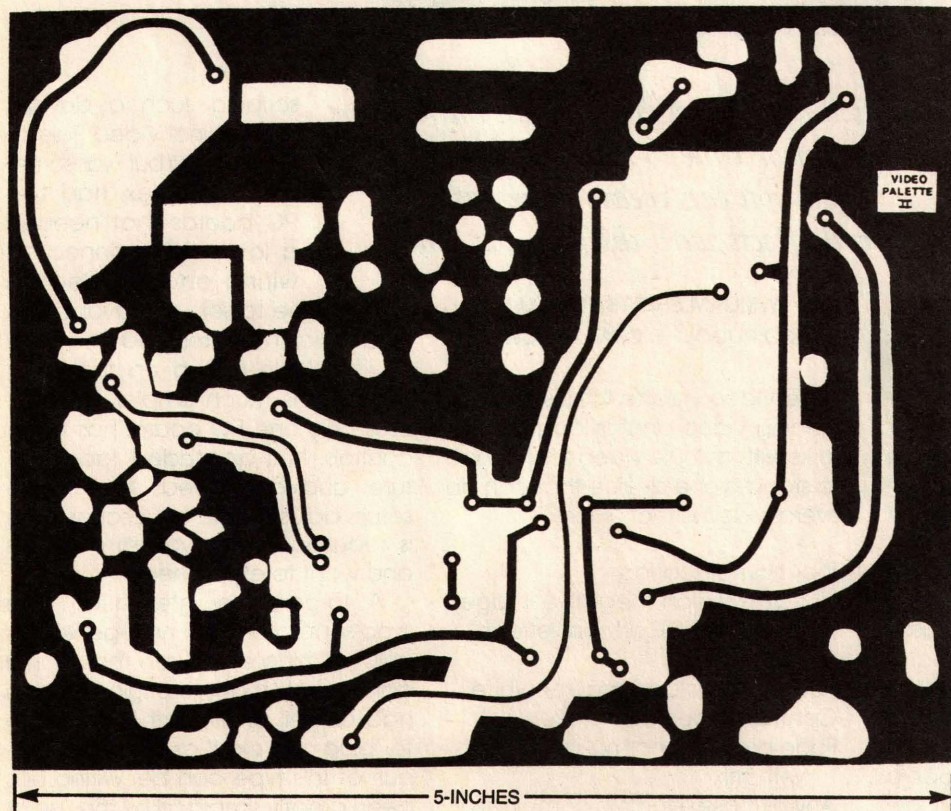
A useful device for photography buffs as well as videographers, the Video Palette II can simulate many photographic effects that are commonly produced in a photo dark-room. It can also be used with a video camera and a monitor for inspection and evaluation of photographic negatives. For example, the invert feature can be used to view the positive image from a negative. A low-cost black-and-white video camera that can be fitted with a close-up lens can be used to inspect black-and-white negatives before printing them. A dedicated setup using a standardized light source and a monitor calibrated with an image of a known-good negative can be used as a video analyzer to determine the exposure and the contrast-grade paper required to

print an unknown negative. The composition and content of a negative can also be viewed to see if it is worth printing. If you do a lot of printing with 8- by 10-inch paper costing 35 to 40 cents a sheet, you can save a good bit of money in paper and chemicals over the long run, not to mention time and frustration. Color can be accommodated with a color camera and monitor, and a light source that can be fitted with an appropriate filter.

Videographers can use the Video Palette II to generate interesting video effects, to experiment with video signals, or to try out ideas before shooting. It can be used as a tool in editing and production of home videos at low cost, where specialized computer and software is unavailable or too costly, or as an introductory device before investing large sums of money in a more complex system.

Special Effects. One of the most useful effects is inversion, which is simply what the name says that it is—a video signal that has its luminance and chrominance parts inverted. In a sense, inversion is the act of "subtraction from pure white." Therefore, blacks become whites, dark grays become light grays, and so all tonality is reversed. In addition, a similar relationship holds for the individual red, green, and blue components; colors are reversed so that they become their complements. Blue becomes yellow, brown (actually a dark orange) becomes a light blue, pink becomes a dark cyan (blue-green), etc. That happens because both the hue and brightness are inverted, resulting in the complementary color. The inverted image is like an unmasked color-photo negative (clear background instead of the usual orange).

Another effect is solarization. Solarization is produced by distorting the



Here's the foil pattern for the component side of the Video Palette II. Be sure to connect all of the holes together between the two sides of the PC board.

gray scale (luminance) in a non-linear circuit so that it folds back on itself. An illustration of the effect is shown in Fig. 1. Figure 1A shows a single line of a video signal that goes from pure white to pure black. Applying solarization to that signal results in the waveform shown in Fig. 1B. The shape of the response curve of the solarization circuit determines the exact effect, and there is no "right way" or perfect method of doing that. The "idealized" waveform shown would not really produce an esthetically-pleasing effect since most of the midtones (grays) would turn bright white—a chalky, unpleasant effect. The best results come from skewing the curve so that only the highlight or lowlight areas are modified. Sometimes, inverting the video before solarization produces a better effect; that waveform is shown in Fig. 1C. A pleasing effect also depends on the scene—one scene might look better with a different effect setting than some other scene. In working with color signals, the chrominance information is distorted with generally unpredictable results. In practice, solarized video

will look better when mixed with some unprocessed video. Again, it is an area where science leaves off and art must take over.

Posterization is the effect of quantizing a video signal into a finite number of discrete levels. For example, if all levels from light gray to white were converted to white, and the middle grays to one tone of gray, and all darker grays to solid black, we would have a video image with only three possible shades: white, medium gray, and black. That gives the appearance of a cartoon drawing or a poster drawn with a very limited color palette. Another example is the "banding" or "pixelated" effect seen on older computers with limited graphics, where only 16 colors could be displayed at any one time. In posterizing, tonality is discarded. The effect, however, is useful in some applications where contrast must be high, such as in line drawings—an extreme example where only solid black and solid white are needed. Other applications include contrast enhancement, such as in text viewing, and in artistic applications. The effect is sometimes used in music

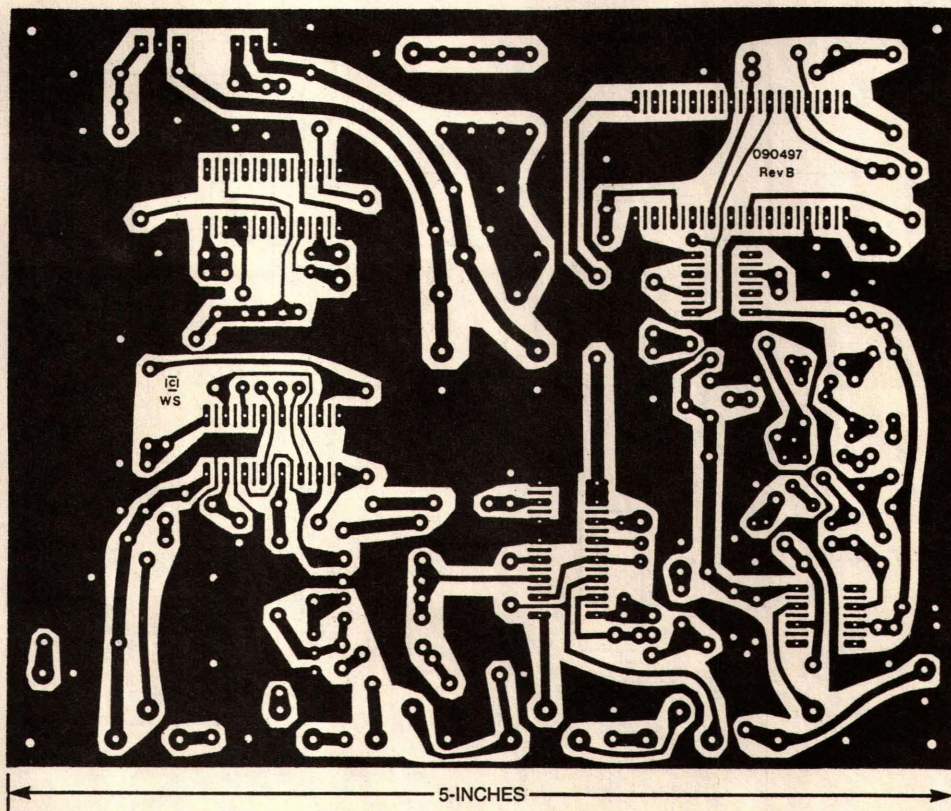
videos. As with solarization, posterized video will look better if it is mixed with some unprocessed video.

Fades are done by mixing a DC level and video in various proportions. The DC level determines ultimately what background the video fades to. In the Video Palette II, fades can be to any shade between and including black or white. Fades to a colored background need an internally-generated color subcarrier that is phase locked to the original color burst. That would require extra circuitry that would make the project much more expensive in relation to the added capability. Besides, most fades are done to black. The fade control can also be used to control contrast and brightness for effects purposes.

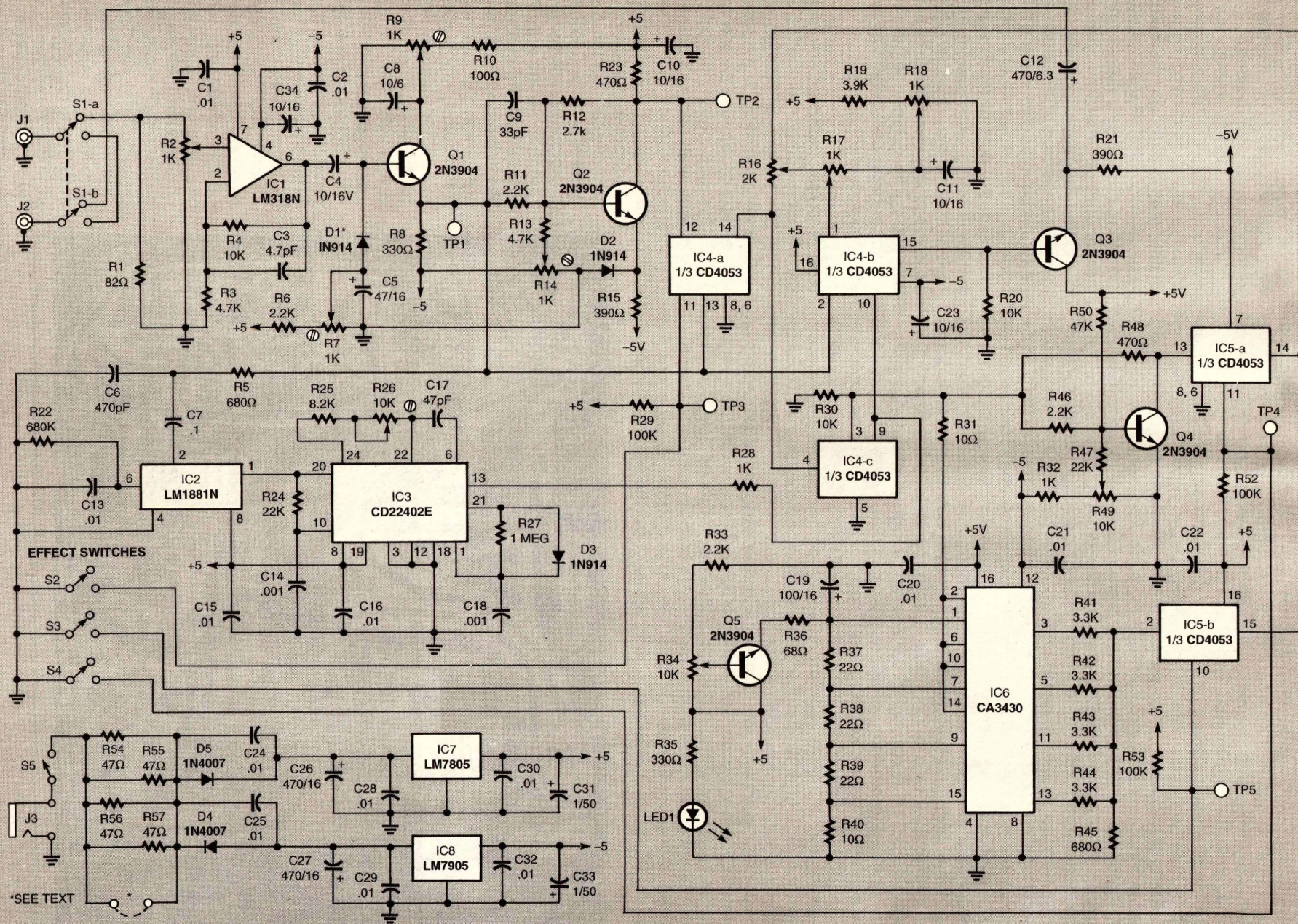
How It Works. The Video Palette II separates the composite video information from the sync and color-burst components. The video is modified with analog circuitry for the various effects. The sync pulses and color-burst portion of the signal is passed on to the output without any modification. That part of the composite

video signal must be preserved since it controls the monitor-sync and color-reference circuits. For example, if inverted video is needed, simply inverting the *entire* composite signal (including sync pulses) will not work; any output monitor will probably not be able to lock onto sync pulses with the wrong polarity, and the DC levels (brightness) will be upset. Also, distorting the video will distort the sync pulses and color-burst.

After processing the video portion of the signal, it is recombined with the sync/color-burst signals and then fed to the output. Effects produced include video inversion, solarization, posterization, and fades to a neutral background (black, grays, or white). The effects can be applied simultaneously in any combination, and the degree of effect

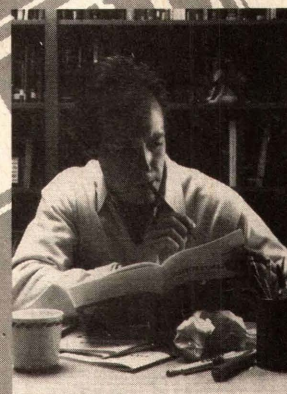


Here's the foil pattern for the solder side of the Video Palette II. Note the large areas of ground plane.



1 Study at Home

We live in a constantly changing world, where exciting new technological advancements are made everyday. At the Cleveland Institute of Electronics we make it simple to train, earn a degree and prosper in the workforce. Over 150,000 students in the United States and 70 foreign countries got their start in electronics through CIE. And they received their education at their own pace in the comfort and convenience of their homes. At CIE you'll receive a first class education by a faculty and staff devoted to your career advancement. All of CIE course and degree programs are taught through a patented, proven learning process. To discover all the benefits and programs/ degrees available from CIE send for your free course catalog today.



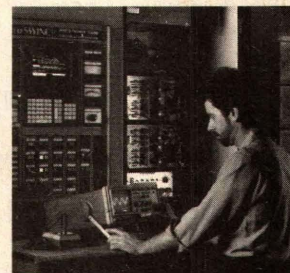
CIE's Associate Degree program contains 397 lab experiments.

2 Work Where You Want

And once you complete your education at CIE, you can just about write your own ticket to where you want to work and in what specialized field... MIS, broadcasting, industrial, automotive, management... The opportunities seem limitless in today's high-tech world.

The Cleveland Institute of Electronics has been approved for use of Veterans Affairs Benefits and DANTES Tuition Reimbursement.

Tuition assistance from the Veterans Administration or the DANTES Program is available to veterans and service members in the Armed Forces.



Employees are seeking & hiring qualified applicants.

FREE CATALOG



1776 E. 17th Street
Cleveland, Ohio 44114-3679

Visit Our Web-Site
www.cie-wc.edu

☐ **YES!** I am interested.
Please send me a catalog.

Name: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

A school of thousands. A class of one. Since 1934.

AE136

produced can be mixed with a normal or inverted signal for obtaining a wide variety of effects from subtle to intense.

Circuit Description. Referring to the schematic diagram shown in Fig. 2, composite NTSC video between 0.5 and 3 volts peak-to-peak from J1 is fed through S1. That switch is used to bypass the Video Palette II circuit and send unmodified video out through J2 if the effects are not needed; that saves the trouble of switching cables. Resistor R1 provides termination, and R2 is a level control. The setting of R2 is crucial to the operation of the effects circuits; the effects-circuits' inputs are level sensitive. Video amplifier IC1 is configured as a non-inverting amplifier with a gain of 3. That way, input signals as low as 0.5V p-p can still be used—lower levels might not be adequate for the effects circuits.

Signals from IC1 (about 1.4 volts p-p) are fed through C4 to the clamp circuit made up of C4, D1, and Q1. Diode D1 can be replaced with a Schottky diode for better clamping at the relatively low signal voltages here. The clamp level is set by R7 for the correct DC level on a normal video signal with C5 as a bypass capacitor. White-level clipping is obtained by limiting the collector voltage on Q1 with R9, R10, and C8.

The output of Q1 (a clamped but unaltered video signal) is fed to analog switch IC4-b, video-inverter stage Q2, and sync-separator circuit IC2. Inverter stage Q2 is fed by R11 and C9. Resistor R12 is a feedback resistor, and a variable negative-DC bias is fed from R14 through R13 to the base of Q2. Bias for Q2 comes from R15, D2, and R23. Gain of the stage is -1.2; that slight gain (remember that this is an inverting stage) compensates for any losses in the analog switches and for circuit-loading effects.

The output signal at the collector of Q2 is a mirror image of the signal at the emitter of Q1. Both signals are applied to the inputs of analog switch IC4-a. The voltage at pin 11 of IC4-a selects which signal is sent to the output; it is set by S2.

The normal video signal from Q1 is fed to IC2 through R5, C6, and C7.

The time constant for IC2 is set by R22 and C13. Composite sync from pin 1 of IC2 is fed to sync generator IC3, which controls the "genlock" for the Video Palette II. Only the blanking information from pin 13 of IC3 is needed; it is used for separating the sync signals from the main video signal by controlling IC4-b and IC4-c. Video from IC4-a is fed to IC4-c, which passes video (but not any sync pulses) to the effects circuitry; the result is a sync-less video signal.

The effects section consists of two nonlinear circuits: a solarizer and a posterizer. The amount of solarization is set by R49. The circuit uses a transistor to form a video amplifier powered by its own input signal. At low-input levels, Q4 is cut off by an adjustable negative bias from R47 and R49. At the junction of R48, pin 13 of IC5-a, and the collector of Q4, the input video signal under that condition is unchanged. As the video-signal level increases (set by R49), enough bias is produced at the junction of R46 and R47 to turn on Q4. That causes the video output to turn negative, or "fold over." The output is fed to IC5-a. When solarization is desired, pin 11 of IC5 is grounded by closing S4. The solarized video appears at pin 14 of IC5-a and is fed to effects control R16. Note that sufficient video level is needed to properly drive the circuit. Levels that are too low to turn on Q4 will not produce any solarization. Although the the chroma and luminance signals should be processed separately for a true solarizing effect, the results do not look as good as when both parts of a color-video signal are distorted together.

Posterization is done by IC6 and its associated components. The circuit uses the high-speed comparators in IC6 to form a rudimentary flash analog-digital converter feeding a simple resistive digital-analog converter. A continuous-tone video is applied to all four comparators at their non-inverting inputs. The inverting inputs are fed a set of reference voltages from divider string R36-R40. The "trip" voltages for the comparators are nominally 0.12, 0.37, 0.62, and 0.87 volts. They can be varied with posterize control R34. The divider is driven from R34 through Q5. The outputs of the comparators are each fed to a

summing network comprised of R41-R45 with the output signal appearing at R45. The output will be one of five levels, ideally zero, 0.25, 0.5, 0.75, or 1.0 volt. That results in a stepped-output waveform with sharp transitions between the levels, appearing as black, dark gray, medium gray, light gray, and white. The actual output levels are higher to allow for circuit losses, but the principle is the same. The resulting pictures have a "blocky" look with all gradation of tones lost, as in a cartoon drawing. Level control R2 must be set so the circuit has adequate input signal. The output of the circuit is fed to analog switch IC5-b. Closing S3 causes IC5-b to pass the posterized video to R16.

One side of R16 has the combined outputs of IC5-a (solarization) and IC5-b (posterization). The other side of R16 has straight video. By positioning the wiper of R16, the amount of processed video and straight video can be varied. The mixture of normal and processed video is fed to one side of fader control R17. A DC level (0 to 1 volt) from the wiper of fade background control R18 is fed to the other side of R17. By varying the position of the wiper of R17, the video level can be varied from full to any given brightness from black to white or any intermediate shade of gray. The fade control can be used to control contrast.

The final video signal from R17 is fed to pin 1 of IC4-b, with the sync signal from the emitter of Q1 at pin 2. With the genlock signal from IC3 controlling IC4-b, the final composite-video signal appears at the output of IC4-b (pin 15). The output signal is amplified by Q3 and sent to S2 and J2 through C12. Overall system gain is unity, depending on the setting of gain control R2.

Power from an 8- to 14-volt AC transformer is applied to J3, with S5 acting as a master on-off switch. Since both +5 and -5 volts are needed by the Video Palette II, the AC power is half-wave rectified by D4 and D5 to create a bi-polar power source without the need for a center-tapped transformer. For that reason, a DC power source will not work. The dropping resistors, R54-R57, help reduce the power that IC7 and IC8 must dissipate when regulating the

voltages. If a lower-voltage power source (8 to 12 volts) is used, R54-R57 can be eliminated and a jumper wire put in their place. Higher voltages than 15 volts are not recommended because of excessive heat resulting from the increased dissipation. However, voltages up to 24 volts AC can be used as long as IC7 and IC8 are given adequate heatsinking, along with the use of higher working voltages (35 or 50 WVDC) for C26 and C27.

Construction. In spite of the Video Palette II's sophistication, it is quite straightforward to build. If you do not wish to purchase a PC board from the source given in the Parts List, foil patterns for the Video Palette II's PC board have been included here. Note that the PC board is double-sided; connections on both sides of the board must be soldered. Many grounded leads have connections on both sides of the board; soldering both sides of those connections will help connect both top and bottom ground planes together for good grounding. That will help get a clean, noise-free picture with no ringing or other undesirable transients.

The parts-placement diagram for the Video Palette II is shown in Fig. 3. Because of the high-frequency sig-

nals, all parts must be mounted close to the board. Short lead lengths are a must for low noise and clean operation. Unless you have the ability to make reliable plated-through holes, a short jumper wire must be soldered to both sides of the board in any hole that does not have a component in it (pass-through).

Begin construction by connecting all of the pass-through holes that will not have components installed in them. The first components to be installed will be the power-supply components: R54-R57, D4, D5, C24-C33, IC7, and IC8. Before continuing, test the supply circuits by applying 9- to 15-volts AC to the input terminals where J3 and S5 will be connected. Check for +11 to +20 volts across C26 and -11 to -20 volts across C27. When the Video Palette II is completely built, the current load will result in a somewhat lower voltage at that point in the circuit. For now, the voltage might be higher than the voltage ratings on C26 and C27; only apply power for a short time (less than 10 to 20 seconds). If everything seems fine to this point, check for +5 volts across C31; pins 8 and 19 of IC3; pin 16 of IC4, IC5, and IC6; pin 7 of IC1; pin 8 of IC2; and the collector pads of Q3 and Q5. Similarly, -5 volts should appear

across C33, pin 4 of IC1, pin 7 of IC4 and IC5, and pin 7 of IC6.

Use an ohmmeter to check the continuity of all traces that have jumpers connecting them to the opposite side of the PC board. Carefully examine the board for any possible shorts between traces, and if any ground plane is too close to a component hole. If there are any problems or questionable areas due to board etching, trim away the excess ground plane with a knife or razor blade, as needed.

Mount all of the fixed resistors, making sure to solder any connections on the top side of the board as well as the bottom side. Once the resistors are installed, proceed with the capacitors. Any capacitors that come with preformed leads should have their leads straightened out with pliers so that they fit as close to the board as possible. Watch for the correct polarity of all electrolytic capacitors when installing them.

The transistors and diodes are installed next. All transistors should be mounted $\frac{1}{8}$ inch from the surface of the board. After the potentiometers are installed, carefully check all of the work done so far for accuracy and orientation of polarized components. Reapply power briefly and verify that the 5-volt supplies are still working. If they are not, a short has occurred somewhere; carefully recheck your work. If the power check is OK, remove power and wait one minute for the capacitors to discharge.

Finally, install the integrated circuits. Again, inspect all of your work so far. Orientation mistakes on the ICs might destroy them the first time power is applied to them. Look for errors such as solder shorts, poor joints, missing parts, and incorrect parts placement.

The Video Palette II is now ready for testing.

Setup and Testing. In order to set up the Video Palette II, you will need the following items:

- A baseband-video source such as a camera or VCR
- An NTSC monitor with baseband video input
- A DVM or analog meter that can easily read 2-3 volts

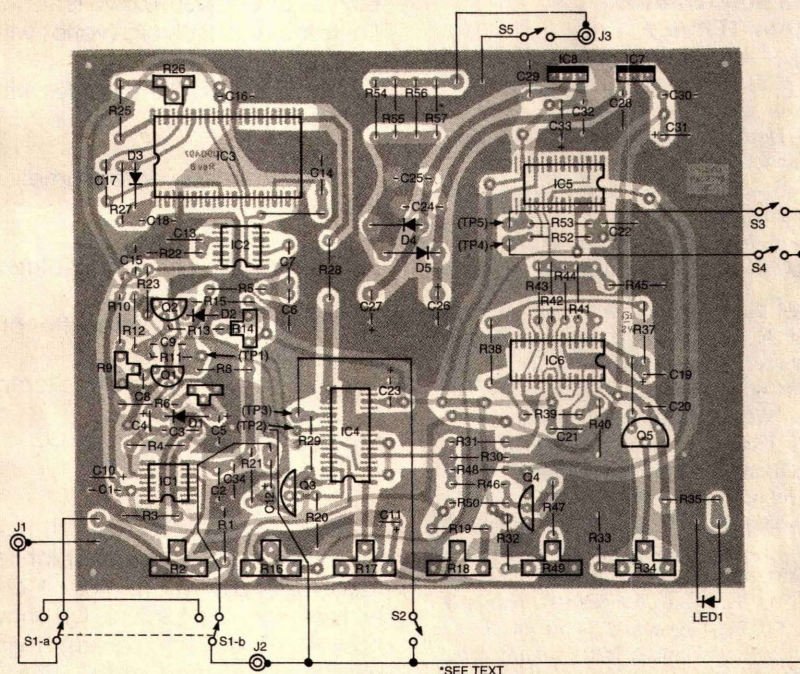


Fig. 3. The Video Palette II is built on a double-sided board with large areas of ground plane. Don't forget to solder connections on both sides of the board where there are pads on the top side—including jumper wires through the holes that don't have any components installed in them.



Fig. 4. Because the Video Palette II uses simple control signals, no high-frequency signals need to leave the PC board. That feature lets you design the front panel to your own requirements. Here's the front-panel design that the authors used on the prototype.

PARTS LIST VIDEO PALETTE II

SEMICONDUCTORS

IC1—LM318N or LM6362N op-amp, integrated circuit
IC2—LM1881N sync separator, integrated circuit
IC3—CD22402E sync generator, integrated circuit
IC4, IC5—CD4053 or MC14053P analog switch, integrated circuit
IC6—CA3430P quad comparator, integrated circuit
IC7—LM7805N 5-volt positive voltage regulator, integrated circuit
IC8—LM7905N 5-volt negative voltage regulator, integrated circuit
D1—D3—1N914 or 1N4148 silicon diode (see text for D1)
D4, D5—1N4007 silicon diode
Q1—Q5—2N3904 NPN silicon transistor

RESISTORS

(All resistors are 1/4-watt, 5% units unless otherwise noted.)

R1—82-ohm
R2, R17, R18—1000-ohm potentiometer, horizontal PC mount
R3, R13—4700-ohm
R4, R20, R30—10,000-ohm
R5, R45—680-ohm
R6, R11, R33, R46—2200-ohm
R7, R9, R14—1000-ohm potentiometer, trimmer
R8, R35—330-ohm
R10—100-ohm
R12—2700-ohm
R15, R21—390-ohm
R16—2000-ohm potentiometer, horizontal PC mount
R19—3900-ohm
R22—680,000-ohm
R23, R48—470-ohm
R24, R47—22,000-ohm
R25—8200-ohm
R26—10,000-ohm potentiometer, trimmer
R27—1-megohm
R28, R32—1000-ohm
R29, R52, R53—100,000-ohm
R31, R40—10-ohm
R34, R49—10,000-ohm potentiometer, horizontal PC mount
R36—68-ohm
R37—R39—22-ohm
R41—R44—3300-ohm

R50—47,000-ohm

R51—not used

R54—R57—47-ohm

CAPACITORS

C1, C2, C15, C16, C20—C22, C24, C25, C28—C30, C32—0.01- μ F, ceramic-disc
C3—4.7-pF, ceramic-disc
C4, C10, C11, C23, C34—10- μ F, 16-WVDC, electrolytic
C5—47- μ F, 16-WVDC, electrolytic
C6—470-pF, ceramic-disc
C7—0.1- μ F, Mylar
C8—10- μ F, 6-WVDC, electrolytic
C9—3.3-pF, ceramic-disc
C12—470- μ F, 6.3-WVDC, electrolytic
C13—0.01- μ F, Mylar
C14, C18—0.001- μ F, Mylar
C17—47-pF, ceramic-disc
C19—100- μ F, 16-WVDC, electrolytic
C26, C27—470- μ F, 16-WVDC, electrolytic
C31, C33—1- μ F, 50-WVDC, electrolytic

ADDITIONAL PARTS AND MATERIALS

J1, J2—RCA or BNC jack, panel-mount
J3—Coaxial power jack, 2.5-mm
LED1—Light-emitting diode, red
S1—Double-pole, double-throw toggle switch
S2—S5—Single-pole, single-throw toggle switch
Potentiometer shafts, 9–14-volt AC wall transformer, case, hardware, wire, etc.

Note: The following items are available from: North Country Radio, PO Box 53, Wykagyl Station, New Rochelle, NY 10804-0053; e-mail: NCRadio200@aol.com; Web: <http://www.northcountryradio.com>; Complete kit of parts including a drilled and etched PC board and all parts that mount on it, switches, jacks, and power connector, \$87.50; etched and drilled PC board (non-plated-through holes), \$25; wall transformer, \$9.50; undrilled metal case, \$21.50; hardware/connectors/wires package, \$10.50. Please add \$4.50 for postage and handling within US (\$10 for orders outside US) on all kit and PC-board orders; \$1 for postage and handling on all non-kit items. NY residents must add appropriate sales tax.

A source of 8-14 volts AC
Cables and connectors to hook up your equipment

Make temporary connections for J1–J3. Connect J1 to a video source and J2 to a monitor. Set R2 to $2/3$ clockwise rotation, R16–R18 fully counter-clockwise, and all of the other potentiometers to the middle of their rotation.

None of the effects switches are needed for calibration; S2–S4, if they've been connected, should be off (open). If you've connected S1, switch it to OUT—video should pass through to the monitor. Set S1 to the IN position for the tests. Make sure that S5 is on if you've connected it, and apply power. Check for +5 volts at TP1 and –5 volts at TP2. Those readings should be within 0.25 volts. Check to see that IC7 and IC8 are not getting too hot. A short or more than +14 volts at their inputs can cause that. At most, IC1–IC6 should get barely warm. Measure the AC voltage drop across R54 and see it does not exceed 3 volts AC. Those checks will show if there are any major shorts in the circuit.

Next, check for the following voltages:

Pin 6 of IC1: 0 volts ± 0.25

Emitter of Q2, Q3: –0.6 volts

Emitter of Q5: 2.0 volts (varies with R34)

Collector of Q1: 2.5 V (varies with R9)

If all is OK, set the potentiometers as follows:

Set R9 for +2.2 volts at collector of Q1

Set R7 for –0.35 volts at emitter of Q1 (TP1)

Set R14 for +1.65 volts at collector of Q2 (TP2)

Set R26 half way (if not done before)

With video applied to J1, you should see a good quality picture. Adjust R2 for a normal picture. If R2 is set too high, the picture will show blocked (white solid areas) highlights. If it is set too low, the picture might be washed out and lose sync. Too low a setting might produce a good picture, but the effects con-

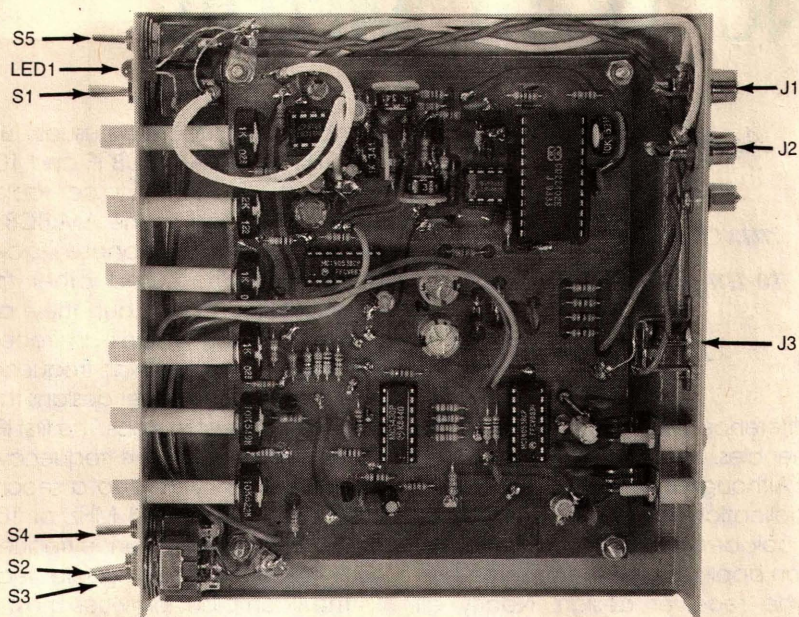


Fig. 5. The Video Palette II has a very neat appearance when wired up.

trols might not work well—especially the level-dependent effects such as the solarizer. In general, R2 will be between one-half and two-thirds open with the video levels produced by most equipment. If there is no picture, check that your source, monitor, and cables are good. If that is not the problem, check your construction again. The Video Palette II should work well on the first try if the construction is correct and error free.

Test the invert function by closing S2 or grounding pin 11 of IC4-a. You should get a negative image. If the picture breaks up and/or has lines through it, adjust R26 for a stable picture that completely fills the screen edge to edge. Verify that the inverted picture is stable with no loss of sync occurring when switching between normal and invert. Adjust R14 slightly if needed for the best-appearing negative image.

Open S2 and close S4 (or ground pin 11 of IC5-a) to check the solarizer. Rotate R17, clockwise and then rotate R49 both ways. You should see a pronounced effect on the video; it will be obvious if the circuit is working. Vary R17 and verify that the degree of solarization can be varied. If little effect is noted, set R2 higher.

Open S4 and close S3 (ground pin 10 of IC5-b). Set R17 fully clock-

wise and vary R34. You should get a posterized picture. There will be some speckles in the posterized areas. They represent the former darkest or lightest points of tonality and show up as a different tone level than the surrounding areas, appearing as noise specks. Vary R17 to mix the posterized and normal video. Level control R2 will affect the results.

Open S3 and reset the front-panel controls to their initial settings. You will get back to a normal unmodified picture. Set R17 to mid-way. Varying R18 should change the picture brightness. Rotate R17 to the extreme clockwise position. The picture should fade to a blank gray screen. Varying R18 should change the gray from black through shades of gray to white. At any setting of R18, it should be possible to fade the video from no picture to full picture.

If all of the tests have passed, the Video Palette II is ready for final assembly.

Final Assembly. The Video Palette II can be mounted in any suitable case. Metal is preferred from an electrical standpoint, but if RFI and stray noise pickup in the video is not a problem, plastic or wood is suitable. Since all of the control switches are handling either DC or low-frequency signals, the layout of the

front panel can be anything you like. The layout of the author's prototype is shown in Fig. 4. If the leads to S1 will be over a few inches long or run close to AC or other video leads, it might be best to use 75-ohm shielded cable.

Figure 5 shows the Video Palette II board mounted in a small metal case. Note how IC7 and IC8 are mounted to the metal case. One precaution: the case of IC7 is at ground while IC8 must be insulated electrically from ground. The Video Palette II uses about 3 watts of power, so heat is not a problem. Small knobs can be used for the front-panel controls, although the plastic-knurled shafts provided with the potentiometers are satisfactory by themselves.

The board is mounted in the case with four metal standoffs and hardware. The result is a clean, simple package with few wires and plenty of access room. Most of the wiring centers around S1.

Using the Video Palette II. Operation of the unit is best learned by experimentation. It is interesting and fun to play with, and you cannot damage anything in the circuit with any combination of control settings. Simply return all controls to the default settings, and a normal picture comes back.

Those with access to an oscilloscope might want to probe around and experiment with video adjustments, examine waveforms, and observe their effect on operation. There are no exact rules or best settings as long as the circuits operate the way you wish. If you are getting satisfactory results, do not worry too much about the exact particulars.

When using the effects at the same time, some slight interaction between controls is normal. If the solarization and posterization effects are not used, it is best to set R16 counter-clockwise in order to avoid some loss of contrast. Note that R2 affects the results and must be set correctly. In normal operation, the Video Palette II is set up for the desired effect and S1, the bypass switch, is used to insert an effect as needed. Alternatively, the front-panel controls can be manipulated,

(Continued on page 60)

WORKING WITH MIXERS

Mixer circuits are designed to operate as frequency translators. They are nonlinear circuits that produce an output frequency spectrum that includes various products of two input frequencies. As shown in Fig. 1, if two input frequencies, F_1 and F_2 , are combined in a nonlinear mixer, then the output spectrum will include the products:

$$F = mF_1 \pm nF_2 \quad (1)$$

where F represents the output products, F_1 and F_2 are the two input frequencies, and m and n are integers (0, 1, 2, 3...). In any given circuit the mixer products may be out to several higher orders. It is commonly, and erroneously, assumed that the output spectrum looks like Fig. 2. Assume that the two inputs are F_1 and F_2 . The outputs will include F_1 , F_2 , F_1+F_2 (sum frequency) and F_1-F_2

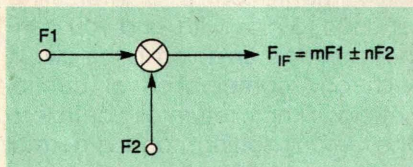


Fig. 1. If two input frequencies, F_1 and F_2 , are combined in a nonlinear mixer, then the output spectrum will include the products $F = mF_1 \pm nF_2$.

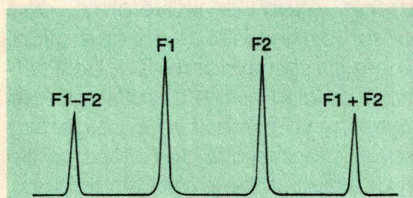


Fig. 2. It is commonly, and erroneously, assumed that the output spectrum of a mixer looks like the graph shown here.

As long as you follow some basic rules, mixer circuits are easy to understand and use.

JOSEPH J. CARR

(difference frequency). Of these frequencies, we usually only need one.

Although there are a number of applications for the mixer, let's take a look at only one. The most common application is the *superheterodyne* receiver design. Nearly all radio and TV receivers sold today are "superhets." In the superhet the incoming RF signal (F_{RF}) is converted to an *intermediate frequency* (IF) by "beating" a local oscillator (LO) signal (F_{LO}) against the RF frequency. That process is called *heterodyning*, from which the name superheterodyne was derived.

Figure 3 shows the block diagram of a typical superhet receiver. The radio signal at F_{RF} is picked up by antenna, and then (sometimes) amplified in an RF amplifier circuit. This signal is mixed with F_{LO} in the mixer to produce two output signals, in addition to F_1 and F_2 : F_1+F_2 (sum) and F_1-F_2 (difference). These frequencies correspond to the results of Eq. (1) when $m = n = 1$.

The IF amplifier is used to process the output signal of the mixer. Either the sum or the difference signal can be used for the IF, as they are mirror images of each other. In AM and FM broadcast band (BCB) receivers, the difference frequency is typically used. In the United States and

Canada, manufacturers usually use 455 kHz as the AM BCB IF, and 10.7 MHz as the FM BCB IF. In car radios, 262.5 kHz is used as the AM BCB IF. European and Japanese radios have sometimes used other frequencies for the IF, but they are close to these values. In recent years, we have seen high frequency (HF) shortwave receiver designs that use two conversion steps. The first IF is around 50 MHz, but this frequency is later down converted to a second IF such as 9 MHz, 8.83 MHz, or 10.7 MHz. In Fig. 3 the difference frequency $F_{LO}-F_{RF}$ is shown being selected.

The IF amplifier provides most of the signal gain found in the receiver. It also provides most of the selectivity of the receiver. The reasons for doing the frequency conversion is that the IF amplifier operates at one frequency only, and that means it is easier to obtain quality selectivity characteristics (the best filters are single-frequency devices) and high gain without either variation in gain with frequency or spurious oscillations.

Mixer Problems. One of the most common problems in using a mixer is the image response. Figure 4 shows how that works. The LO and RF are separated by the amount of the IF. Unfortunately, that means that there are two frequencies separated from the LO by the amount of the IF. In Fig. 4 the RF is located at $F_{LO} - F_{IF}$. Ideally, that is the only frequency that is received. But notice that $F_{LO} + F_{IF}$ (the "image" frequency) is also valid. Any signal that appears at the image frequency will also appear to the receiver as a valid IF signal.

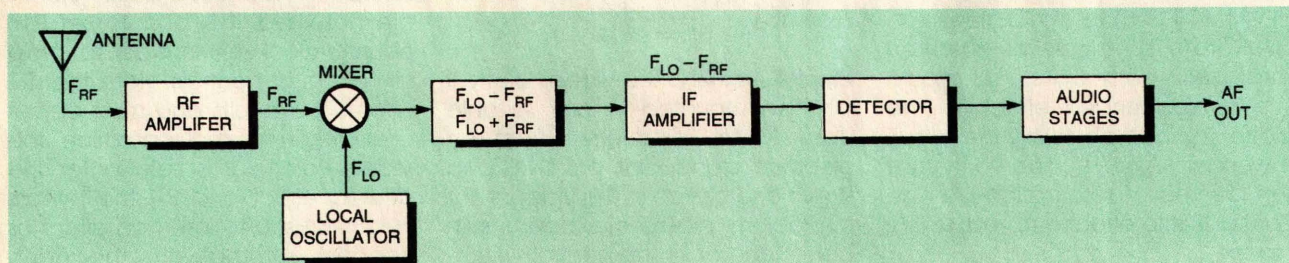


Fig. 3. A block diagram of a typical superheterodyne receiver. Though the difference-signal output of the mixer is used here, either the sum or difference signal output could be used.

The problem doesn't end there, unfortunately. The receiver has a certain bandwidth (BW). No signal has zero bandwidth, so a receiver designer will match the bandwidth with the modulation being received.

Typically, an AM BCB signal likes to see 10 kHz, an AM shortwave signal 6 kHz, an SSB signal 2.7 kHz, a land-mobile FM signal 5 kHz, and an FM BCB signal 200 kHz. Any signal that falls within the bandwidth will appear in the IF amplifier as a valid signal. Thus, all of the signals at $F_{RF} - (BW/2)$, i.e. around the RF signal in Fig. 4, and $F_{RF} + (BW/2)$, i.e. the image, will appear in the IF amplifier.

Notice in Fig. 4 that the baseline is not a nice clean line as it was in our ideal case of Fig. 2. Rather, there is a lot of noise in the system. The noise might be noise from the environ-

ment (both natural and man made), or it might be noise generated by the circuits inside the receiver. Even a simple resistor with no current flowing in it will produce a noise signal due to thermal agitation of the electrons inside the resistor material. Thus, in addition to any radio signals that might be present in the vicinity of the RF and image frequencies, any noise present will also appear in the IF amplifier.

It gets better: The local oscillator signal might be somewhat imperfect. Indeed, it will be imperfect... there's no "somewhat" about it. Three problems exist: LO harmonics, LO noise, and *discretes*.

Figure 5 shows the situation with respect to harmonics. All signals other than a perfect sinewave produce harmonics, i.e. signals of inte-

ger multiples of the basic signal. Thus, a 1000-kHz signal will have harmonics of 2000 kHz, 3000 kHz, 4000 kHz, and so forth, unless they are truly pure sinewaves (not likely).

In the example of Fig. 5 the LO signal (F_{LO}) has harmonics of $2F_{LO}$ and $3F_{LO}$. Any signals or noise that falls within the bandwidth (or pass-band) also appears around those harmonics plus or minus the IF: $2F_{LO} \pm (F_{IF} \pm (BW/2))$.

Figure 6 shows another problem with the LO signal: noise. The LO signal is ideally a spike with only amplitude and no width. That doesn't occur in practice. The real LO signal will have several different forms of noise around it. There will be signal components caused by thermal noise in the oscillator circuit. There will also be single-sideband phase noise present. These are difficult to filter out unless the LO is a single-frequency circuit, and its output signal can be passed through a very narrow (high Q) bandpass filter.

Discretes are modulation of the LO signal (either AM or FM) caused by other frequencies in the circuit. Of course, it's possible for oscillators and other signals within the circuit to modulate the LO, but the principal source of discretes is improperly filtered DC power-supply voltages. The AC power-line frequency in North America is 60 Hz (in some other parts of the world 50 Hz is used). When full-wave rectified, this produces a 120-Hz (twice the line frequency) ripple-frequency signal on the DC output of the power supply. If the ripple signal is allowed to remain on the DC power line, then it will modulate the LO signal and possibly cause problems.

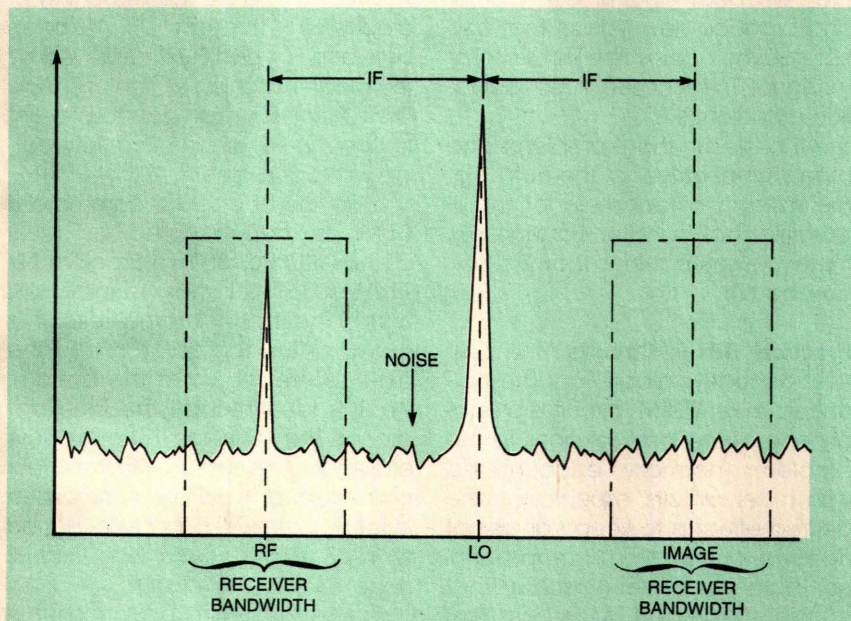


Fig. 4. While the RF signal located at $F_{LO} - F_{IF}$ is the desired one, an image signal located at $F_{LO} + F_{IF}$ is also valid.

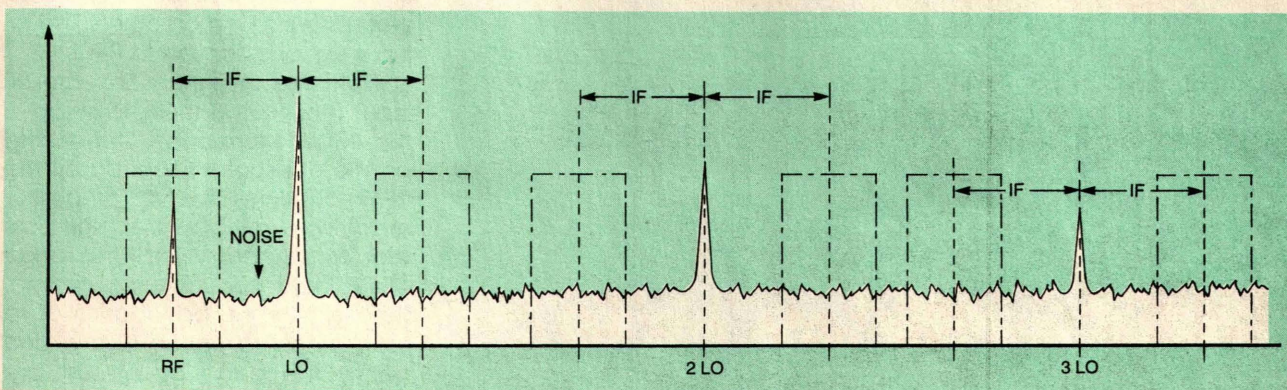


Fig. 5. Any noise that falls within the receiver's passband also appears around any internally generated harmonics.

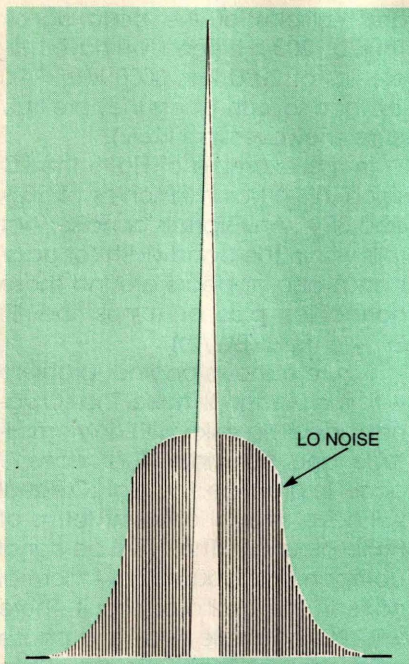


Fig. 6. While the LO signal is ideally a spike with only amplitude and no width, a real LO signal will have several different forms of noise around it.

Power supply discrettes fall so close to the LO signal that they cannot usually be filtered out of the LO signal. They must be filtered out before they arrive at the LO. To cure this problem with the LO (as well as others), it is customary in high-quality receivers to provide adequate decoupling and filtering of the DC power lines and to provide the LO circuit with a voltage regulator of its own. The voltage regulator must be separate from any others used for the rest of the receiver.

Noise produced by the oscillator itself can be minimized by using a low-noise transistor or IC device, and by proper mounting of the components. A major contributor to phase

noise, for example, is movement of the components. Remarkably small amounts of motion on frequency-determining components, or other components that affect frequency indirectly, can cause FM, PM, or phase noises.

Note that the spectrums shown in Figs. 4 and 5 assume that there are only two frequencies present (F_1 and F_2 , or F_{RF} and F_{LO}). That rarely occurs in real situations. In the radio receiver, for example, there are a lot of signals arriving at the antenna simultaneously. They can cause problems even if they are not situated at the RF and image frequencies (or at their phantoms around the harmonics of the LO). If a group or spectrum of signals appears at the RF input port, then all of them will be converted by the LO. In addition, they will beat against each other and produce new signals that also heterodyne against the local-oscillator signal. This is called intermodulation distortion (IMD)

All in all, with these problems and others, what arrives at the output of the mixer is a real mess for the IF amplifier to handle. Fortunately, there are some things that we can do about it.

Practical Mixer Circuits. The passive Schottky diode double-balanced mixer (DBM) circuit is probably one of the best solutions to the problems normally encountered with mixer circuits, especially if the desired effect is to keep signals not needed out of the IF amplifier. A non-balanced mixer (which is what is in most AM and FM BCB radios) passes the two input frequencies and all of their products to the IF

output (as in Fig. 2). A single-balanced mixer will suppress either F_{LO} or F_{RF} , but not both. A double-balanced mixer, on the other hand, suppresses both F_{LO} and F_{RF} in the IF output, so the output only contains the sum and difference products. A well-designed DBM will also suppress the even harmonics of the LO and RF input signals.

The DBM circuit in Fig. 7 consists of a diode ring (D1-D4) of Schottky devices, and two 1:4 BALUN transformers in which the 4R winding is center-tapped. The LO and RF signals are applied to the ends of the ring, and the IF is taken from the center-tap of T2, the RF input transformer. The degree of suppression of F_{RF} and F_{LO} is determined by the degree of balance. The balance is controlled by the construction of transformers T1 and T2, and by the matching of diodes D1 through D4. Isolation between F_{LO} and F_{RF} is improved by the diode switching action of D1-D4. The switching action acts to prevent transformers T1 and T2 from interacting with each other.

One line of popular commercial DBMs is manufactured by Mini-Circuits (P.O. Box 350166, Brooklyn, NY 11235-0003; Web: www.minicircuits.com). The basic internal circuit is shown at the top of Fig. 8, and the pin-outs are shown at the bottom. Pin 1 is identified by the blue dot around the terminal. There are several models popular with amateur builders, and these are summarized in Table 1. These mixers are designed for a +7 dBm LO signal level and RF signal levels up to +1 dBm.

Figure 9 shows a basic circuit in block-diagram form for using the Mini-Circuits' mixers. In this case the SBL-1 is selected, but the same pinouts are found on others. The RF input signal is applied to Pin 1.

Note the presence of some RF input filtering. It is there to improve the IMD performance. Depending on the application, specifically the RF frequencies involved, the filter might be a low-pass filter, high-pass filter, or bandpass filter. If the range of RF input frequencies is limited, then opt for the bandpass filter so that undesired signals above and below the band of interest are attenuated. Otherwise, determine where the interfering signals are

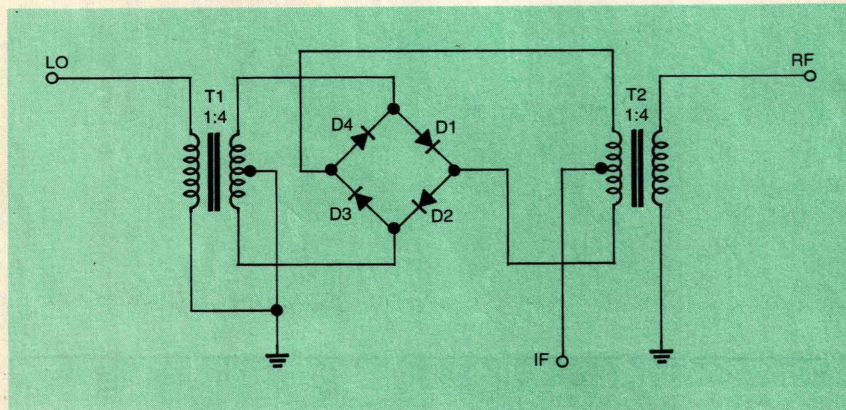


Fig. 7. Here's a generalized schematic for a diode-ring double-balanced modulator.

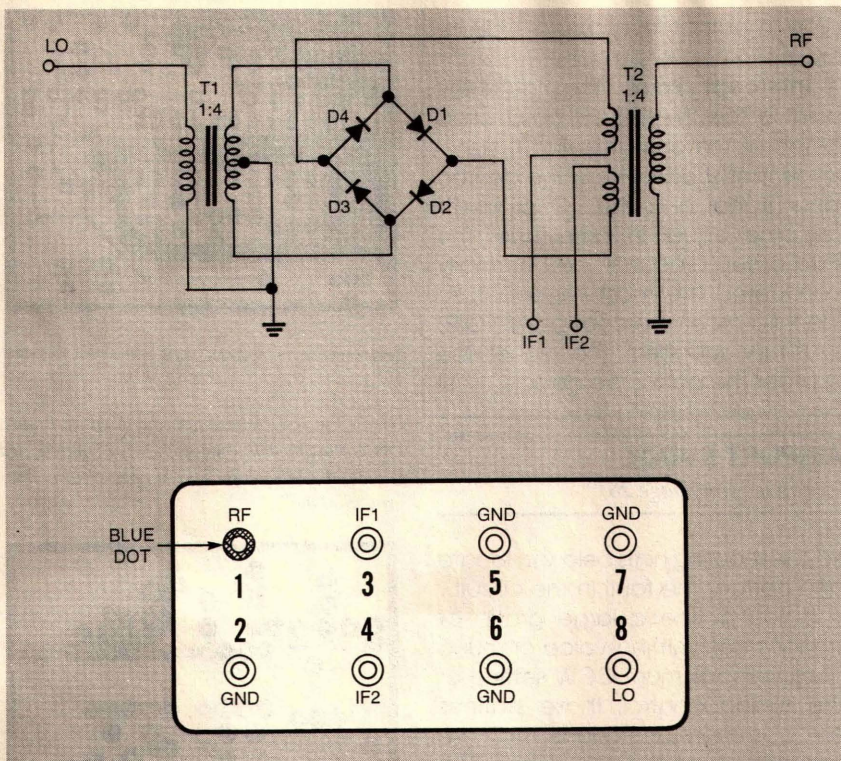


Fig. 8. One popular line of DBMs is made by Mini-Circuits. Here is the basic circuit and pinouts for the members of the series. More details can be found in Table 1.

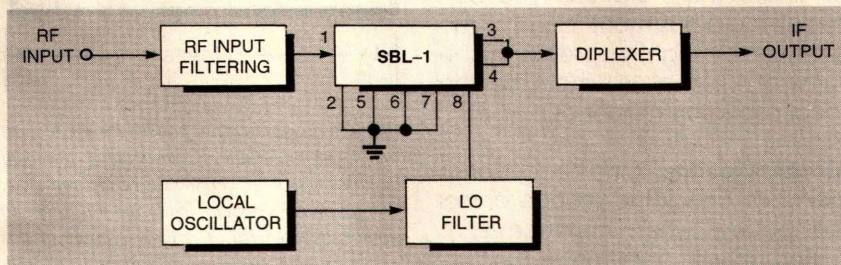


Fig. 9. This block diagram shows how the Mini-Circuits' DBM is typically used.

TABLE 1—MINICIRCUITS MIXERS

Model No.	LO/RF	IF	RF Pin	LO Pin	IF Pin	Ground Pins	Case
SRA-1	0.5-500	DC-500	1	8	3,4*	2,5,6,7	2
SRA-1-1	0.1-500	DC-500	1	8	3,4*	2,5,6,7	2
SRA-2	1-1000	0.5-500	3,4*	8	1	2,5,6,7	2,5,6,7
SBL-1	1-500	DC-500	1	8	3,4*	2,5,6,7	None
SBL-1-1	0.1-400	DC-400	1	8	3,4*	2,5,6,7	None

* Pins must be connected together

with respect to the desired signal and select a type of filter and cut-off frequency that either gets rid of the most signals or the most dominant signal. Whichever filter is selected, however, it must be designed to terminate in a 50-ohm resistive impedance.

If a very pure frequency conversion is necessary (as in a high-quality receiver or converter), then

place a filter in the line between the LO output and the mixer's LO input. As with the RF filter discussed above, select the filter that eliminates the greatest amount of undesired energy. For the most part this means a low-pass filter with a cut-off frequency above the highest LO frequency and the lowest harmonic. Sub-harmonics are also an issue, but are usually less of a

problem. If they are, then either use a bandpass filter centered on the LO range, or cascade a low-pass and high-pass filter.

The local oscillator must be able to produce an output level that will produce a power level of +7 dBm at the LO input (pin 8). The LO output power must be sufficient to overcome the losses of the filters and any other components in the signal path, yet still produce +7 dBm at the LO input of the mixer. For example, if the filter has a 2 dB insertion loss, then the LO must produce +9 dBm output power into a 50-ohm load.

Some designers place a 1- to 3-dB fixed broadband attenuator in each of the signal lines of the mixer. The idea is to damp impedance excursions and to allow the mixer to see a constant 50-ohm source or load impedance at each pin. If you use well-designed filters for the inputs and terminate the IF output properly, then the attenuator should not be necessary. If you prefer to use attenuators, however, the Mini-Circuits' catalog (see their Web site) has examples.

The best way to terminate the IF output of the mixer is to use a diplexer circuit. A diplexer is a circuit that produces a constant impedance over a broad range of frequencies, and will pass a desired frequency and (here is the important part) absorb undesired frequencies. One way to build a diplexer is to connect both high-pass and low-pass filters at the IF output of the mixer. Depending on whether you want the sum or difference frequencies, connect the output of one filter to the load being served (e.g. a following amplifier) and the other to a resistive dummy load that is matched to the system impedance

Diplexer Design. Figure 10 shows a practical bandpass diplexer design intended for use with mixers. The values of the R_0 resistors is the system design impedance (50 ohms in most cases). The values of $L1$, $L2$, $C1$, and $C2$ are determined by the center frequency (f_0) of the desired pass band. The Q of the filter is f_0 divided by the necessary bandwidth (BW). The values of these components for

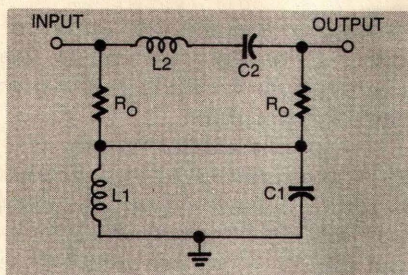


Fig. 10. Here's a practical bandpass diplexer design intended for use with mixers. Values are calculated using the equations in the text.

any given frequency can be calculated from the equations below:

$$Q = \frac{f_o}{BW_{3dB}}$$

and

$$\omega = 2\pi f_o$$

The component values are:

$$L2 = \frac{R_o Q}{\omega}$$

$$L1 = \frac{R_o}{\omega Q}$$

$$C1 = \frac{1}{L1 \omega^2}$$

$$C2 = \frac{1}{L1 \omega^2}$$

Mixer Selection. Several different specifications may be applied to a mixer when making a selection. First you want to select the frequency range. Don't select a mixer that barely covers the frequency you are interested in. For example, if you want to handle an RF input signal of 1.2 MHz, don't select a 1- to 400-MHz device. Select a device with a 0.5- or 0.1-MHz lower end. Keep in mind the RF, LO, and IF frequencies when selecting the mixer for an application. Here are some other specifications to keep in mind:

Isolation. The LO-RF, LO-IF and RF-IF isolation tells you something about how much signal will feed through the pathway specified. For example, the LO-RF isolation tells you the amount the LO signal is attenuated when it reaches the RF port. Numbers such as 30 to 60 dB are common.

Dynamic Range. This specification tells you the power range in which the mixer works properly. It is a good idea to obtain the highest dynamic range possible.

-1 dB Compression Point. The input signal level that causes a 1 dB

drop in output level, i.e. a 1 dB increase in conversion loss.

Intercept Point. The intercept point is the theoretical point on a graph of the output-vs.-input signal levels that shows where the desired input signal and the n^{th} products become equal in amplitude. The third-order products are normally considered the most important, so the third-order intercept point (TOIP) is usually specified. The higher the number the better the device. Ω

AIRPORT BUDDY

(continued from page 28)

troubleshooting hints below to locate and correct the fault in the circuit.

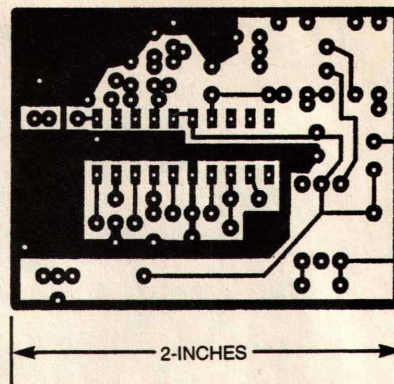
If you notice a large group of stations transmitting voice or music near the maximum CCW setting of the tuning control, those stations are commercial stations that are transmitting at the top of the FM-broadcast band. If you want to eliminate those stations, you can tweak the adjustment range of the receiver by slightly spreading the turns of L1; that will increase the local-oscillator frequency.

Troubleshooting. If the headphones are silent, check the voltage across the battery when the receiver is turned on with a voltmeter. The battery voltage should be at least 8 volts—weak batteries will not drive the Airport Buddy. Also measure the current; the normal value is about 10 milliamps. The polarized components (D1, IC1, Q1, and the electrolytic capacitors) should be checked for proper orientation. The voltage at pins 5 and 6 of IC1 should be at least 7 volts. If it isn't, D1 might be installed backwards.

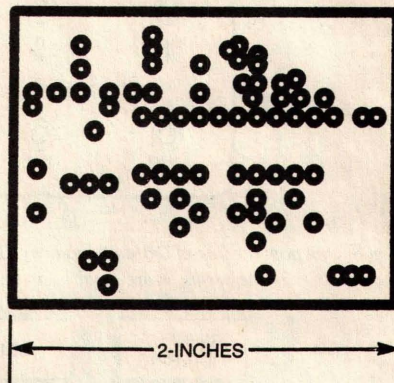
If power to the circuit is normal, check the voltage at pin 7 of IC1. It will normally be about 0.25 volts or less when no signals are being received and increase when an RF carrier is detected.

Check the voltage at the source of Q1. If it is about 1 volt, the transistor is drawing current. If not, check its orientation or try a new transistor.

If it is suspected that IC1 is not operating, carefully check the components that form the local oscillator: R1, C3-C6, L1, and D2. Check the



Here's the foil pattern for the Airport Buddy. The circuit is simple enough for a single-sided layout; the other side is a simple solid-copper ground plane.



Although this is not a foil pattern for the Airport Buddy's ground plane, it shows the locations of the holes where copper should be cleared away so that the component leads do not short to ground. If you wish, a negative image of this layout could be used as a "foil pattern" that will only etch away a ring around the holes that need to be clear.

bias on D2 to be sure that it changes when R6 is turned. Measure the voltage at each pin on IC1 and compare the reading with Table 2. The voltages listed assume that the battery voltage is at least 7 volts. If any pin on IC1 does not seem right, carefully check the wiring for short circuits. If a fault cannot be found, replace IC1.

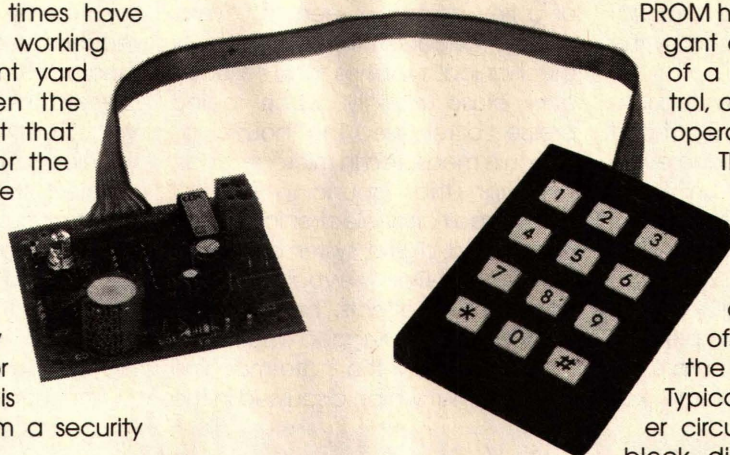
Using the Airport Buddy. When receiving signals at the airport, adjust the tuning control over its range very slowly to search out any possible transmissions. Once you have found the active frequency of the control tower, you can then keep the tuning control in that general vicinity to hear the audio communications as each aircraft arrives and takes off. Ω

A GARAGE-DOOR KEYPAD

How many times have you been working in the front yard and wanted to open the garage door—except that the remote control for the garage door is in the car...in the garage? Perhaps you have a particular model of opener that doesn't have a keyless-entry module as an option or that has an option that is not well designed from a security standpoint.

The Garage-Door Keypad presented here will work with almost any type of mechanism. In addition to the convenience of providing keyless entry for members of your household, you'll find it useful in many other circumstances: going out for a bike ride, working in the back yard, etc. Its advantage over commercially-available units is that it is self-powered from the two-wire relay circuit that already exists with most installed openers—no battery, no separate 110-volt AC or inconvenient outlet transformer is needed! It's also designed to be more secure than conventional keyless entry systems. In addition to its added convenience, it's another excellent opportunity to learn about the popular PIC microcontroller and serial EEPROM devices, which are at the heart of the unit.

Functional Overview. The Garage-Door Keypad is extremely simple to operate: To program an entry code, a program button is pressed inside the unit (normally out of reach inside the garage). A sequence of numbers up to 127 digits long is entered followed by the "#" button. The unit then stores that number sequence. Access is allowed (by operating a relay) when the same sequence is typed in followed by the "#" button. Additional security is provided by time-outs. Furthermore, only the keypad is located outside the garage. It is connected to the electronics by a ribbon cable. Thus,



Operate a garage-door opener without having to find the remote transmitter!

REINHARD METZ AND
DAVID WICKLIFF

a potential intruder will not be able to pry the unit off its mounting and short the two wires going to the door mechanism to gain access. That scenario, unfortunately, is quite possible with some commercial units or key-based switches.

Design Overview. The basic hardware of the Garage-Door Keypad consists of just four main components: a PIC 16C54 microcontroller for the logic, a 93AA46 serial EEPROM for access-code storage, the keypad itself, and a power circuit. Figure 1 shows the schematic diagram. The PIC microcontroller, IC1, scans program button S1 and keypad S2 through a matrix formed by eight I/O lines. The lines are pulled up by R4 so that IC1 always sees a valid logic level. When scanning the matrix, one output line is grounded. If a key connected to that line is pressed, the input line that it is connected to is also grounded. The scanning process will be described later.

The microcontroller connects to IC2 with three leads. The serial EE-

PROM has a very simple and elegant operation, which consists of a sequence of serial control, addressing, and data I/O operations.

The self-powering part of the Garage-Door Keypad is provided by BR1, which rectifies what typically appears as an AC or DC voltage of from 10 to 24 volts from the garage-door opener. Typically, a garage-door opener circuit works similarly to the block diagram shown in Fig.2. Normally, the opener's switch activates the mechanism by shorting the relay wire to ground. That closes a relay or circuit in the opener. The Garage-Door Keypad "steals" some of the current that appears across the switch. What makes this "trick" work is that the Garage-Door Keypad uses less current than is needed to energize the relay—thanks to the low power requirements of IC1.

To energize the opener, RY1 shorts the control leads for one second. During that time, the Garage-Door Keypad is without power. The circuit is kept alive during that time by the energy stored in C3. That is the reason for the extremely high value of C3—47,000 μ F. Finally, IC3 regulates the filtered power to 5 volts for the logic. While many—especially older models—garage-door openers will work with that power scheme, some newer models might not. In that event, a pair of jumpers can be removed so that power is not drawn from J1. Instead, the circuit can be powered from an auxiliary wall transformer connected to J2.

Firmware Overview. The software for the Garage-Door Keypad is written in PIC assembly language and is programmed into the on-chip EEPROM of the microcontroller. Both the source code file and a compiled hex file for programming IC1 are available for downloading from the Gernsback FTP site (<ftp.gernsback.com>). 45

com/pub/EN/garage.zip).

The software is written in the form of a large loop that executes repeatedly. The flow chart of the software is shown in Fig. 3. When power is applied to IC1, several program variables that are used by the software are set up.

The first step of the main loop is to set up the input- and output-port pins of IC1. That must be done every time that the main loop is run. That's because the port settings are reset each time IC1 is reset from either power being applied to IC1 or, as we will see later, a "watchdog" reset.

Next, the keypad is sampled for any new key presses. A key press is considered valid if the same key

value is sampled on two consecutive passes of the main loop. That is done to "de-bounce" the key contacts. At the speed that IC1 can execute instructions, a single press of a key might be seen as several presses because the contacts of mechanical switches tend to open and close rapidly when being pressed or released. The "bouncing" action is measured in microseconds. Although that bouncing doesn't affect traditional electronic circuits, high-speed digital systems such as the Garage-Door Keypad need to consider such effects. The value of a valid key press is flagged and stored for later use by the state-machine software that will be discussed in the

next section.

After the keypad is scanned, a keypad-entry-timeout variable is decremented. On each pass of the main loop, this counter is decremented by one. If the count ever reaches zero, all key presses are cleared. However, whenever a key is pressed, the counter is set to a large value. That way, the keypad counter will clear any partial key sequences entered that are not completed within about 60 seconds (if, for example, the neighbor's kid is playing with the keypad or a basketball hits it). Therefore, the next time someone enters a valid key sequence it will be recognized correctly.

After updating the key-entry time-

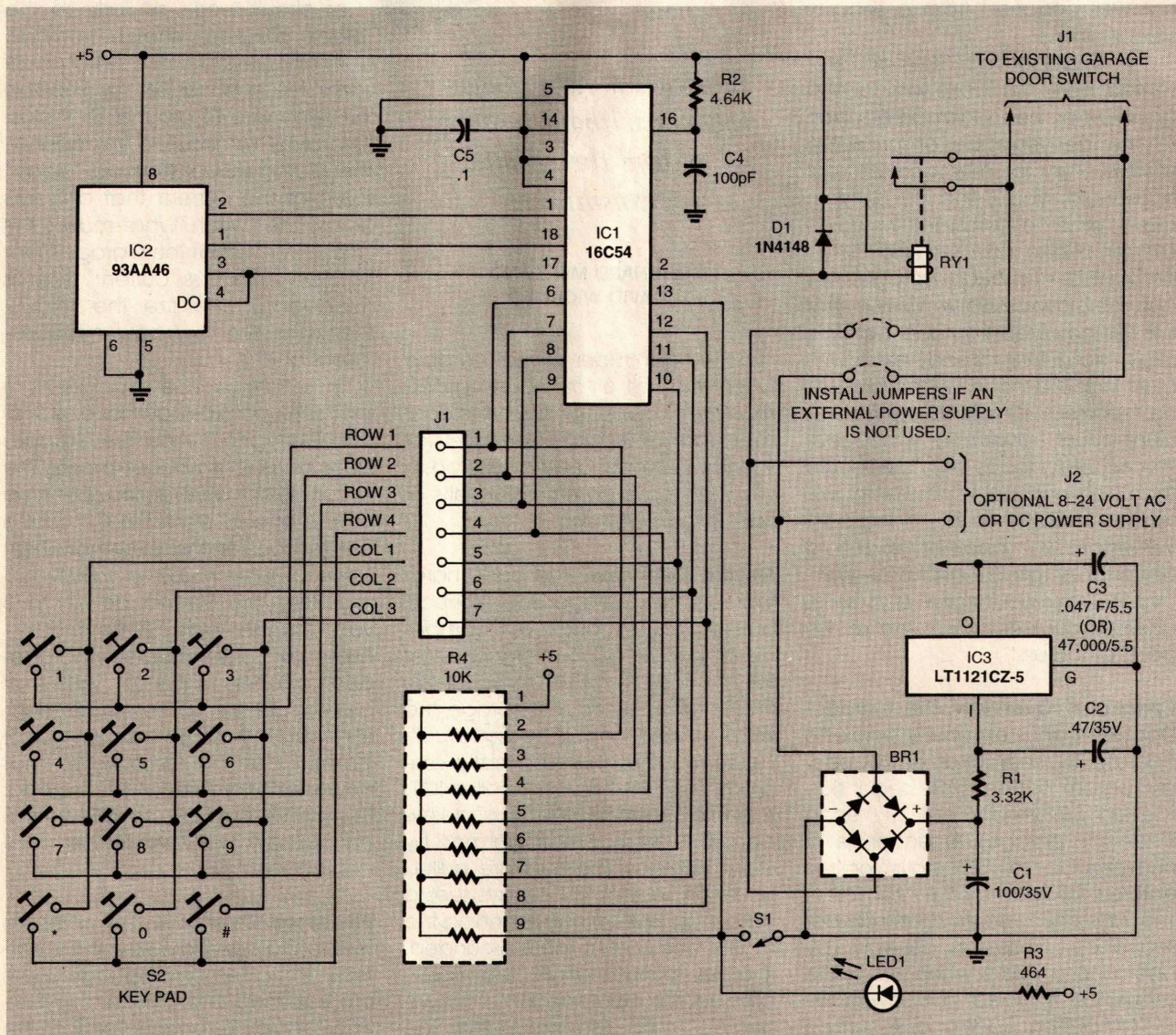


Fig. 1. The Garage-Door Keypad is a simple circuit that is built around a PIC microcontroller. The entire circuit draws less than one milliamp, so it can be powered by the voltage that comes from the garage-door opener connected to J1. Since RY1, when operating the garage-door opener, shorts out the power source, C3 is used as a battery backup—keeping the circuit alive until RY1 releases.

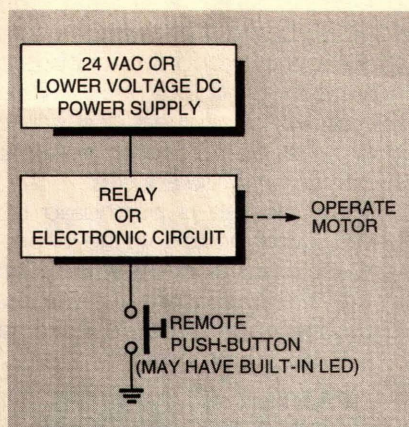


Fig. 2. Most garage-door openers have a voltage present across their remote pushbuttons. As long as less current than what the garage-door opener's relay needs to trigger is drawn, an additional circuit (like the Garage-Door Keypad) can be powered without tripping the garage-door mechanism.

out, the state-machine routine is run. As we will see in the next section, that routine performs most of the Garage-Door Keypad's functions.

Finally, the loop ends with a "sleep" command, shutting down IC1. An on-board watchdog timer resets IC1 when it times out (about every 18 milliseconds), starting the software loop over again. Normally,

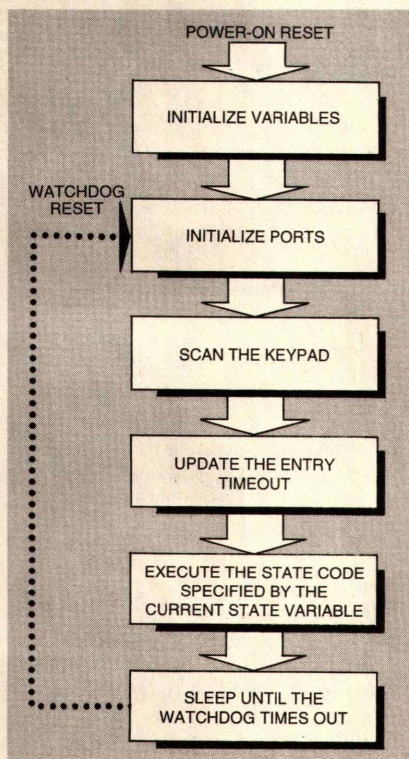


Fig. 3. The Garage-Door Keypad's software is a simple loop that executes once and "goes to sleep" until an on-board timer in IC1 triggers, resetting IC1 and starting the loop over again.

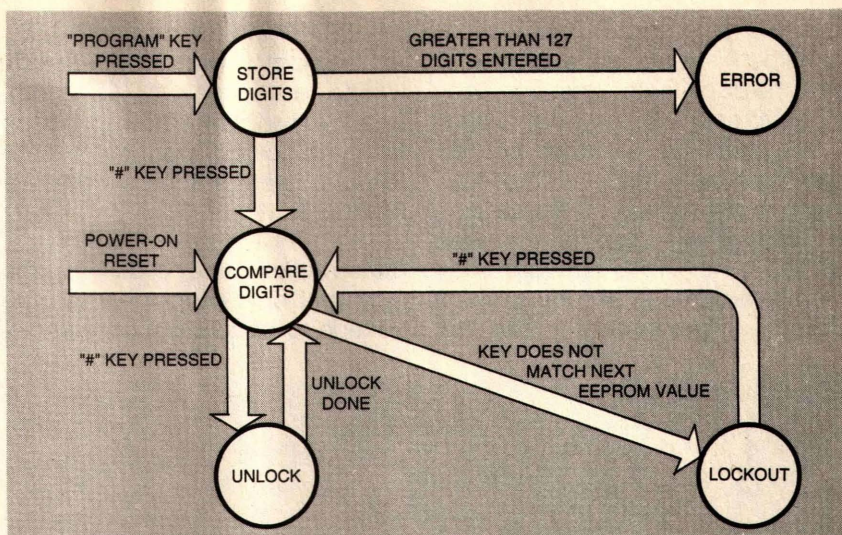


Fig. 4. One way to write a complex program is to divide up the task into many small tasks; the approach is called the "software-state machine." That approach is used by the Garage-Door Keypad. This diagram shows the various states and their relationships to each other.

a watchdog timer is used to prevent accidental "lockup" of the micro-controller. When it is used that way, the software would frequently clear the watchdog timer so that it is not allowed to time out.

The Software-State Machine.

Most of the software in the Garage-Door Keypad is organized using a software programming technique called the *software-state machine*. In that method, the various "states" of a program are diagrammed with a traditional state diagram. A small piece of software code is then written for each state in the diagram. A variable is used to identify in what state the machine should be. That variable determines what piece of code should be run. The software-state method lets a programmer organize and break-down a large problem into smaller and more manageable pieces. An example of a software-state diagram—the Garage-Door Keypad's software-state diagram—is shown in Fig. 4.

The state variable in the Garage-Door Keypad's source code is simply called *STATE*. The main loop software uses the current value of *STATE* to pick the correct software segment to run each time through the loop. One interesting programming technique is when a code segment changes the value of *STATE*, thereby forcing the state machine into a different state.

A power-on reset starts the state machine off in the *COMPARE DIGITS* state. Any entered keys are compared to the series of key values that are stored in IC2. The state machine remains in the *COMPARE DIGITS* state as long as the entered keys match the *xmachine* advances to the *UNLOCK* state. If ever an entered key does not match the next key stored in EEPROM, then the state machine advances to the *LOCKOUT* state. An example of that is if the stored combination is "1-2-3-4." If the keys "1," "2," "3," and "4" were pressed, the "#" key would change the state machine to *UNLOCK*. If, on the other hand, only the keys "1," "2," and "3" were pressed, the "#" key would change the state machine to the *LOCKOUT* since the two codes don't match.

The *UNLOCK* state simply activates RY1 for about one second, opening or closing the garage door. The *LOCKOUT* state will ignore any additional entered keys until the "#" key is pressed. In that way, a potential intruder is not alerted to the fact that the key sequence that was entered has stopped matching the stored sequence in IC2.

If S1 (the "program" key) is pressed at any time, the *STORE DIGITS* state is entered. In that state, any entered keys are sequentially stored in IC2 until the "#" key is pressed. As a general rule when designing state-machine code, the software segments for each state should not loop within themselves; they should per-

form the desired action only once and then exit. As an example of that, the code for the STORE DIGITS segment stores only one digit at a time.

You can see the logic behind the STORE DIGITS state in the flow chart shown in Fig. 5. The STORE DIGITS state-software segment, as well as the other state-software segments, makes use of a number of support subroutines for blinking

the LED (*BlinkLED* and *WinkLED*), reading data from IC2 (*EEPRead*), writing data to IC2 (*EEPWrite*), and delaying any further action for a specified period of time (*Delay*). See the source code file for details.

Construction. The circuit for the Garage-Door Keypad is simple enough to be laid out on a single-

sided PC board. If you wish, you can make your own board; a foil pattern has been provided here. As an alternative, an etched and drilled board can be purchased from the source given in the Parts List.

If you do use a purchased PC board or one made from the foil pattern, the parts-placement diagram in Fig. 6 shows where the various parts are located. Before installing

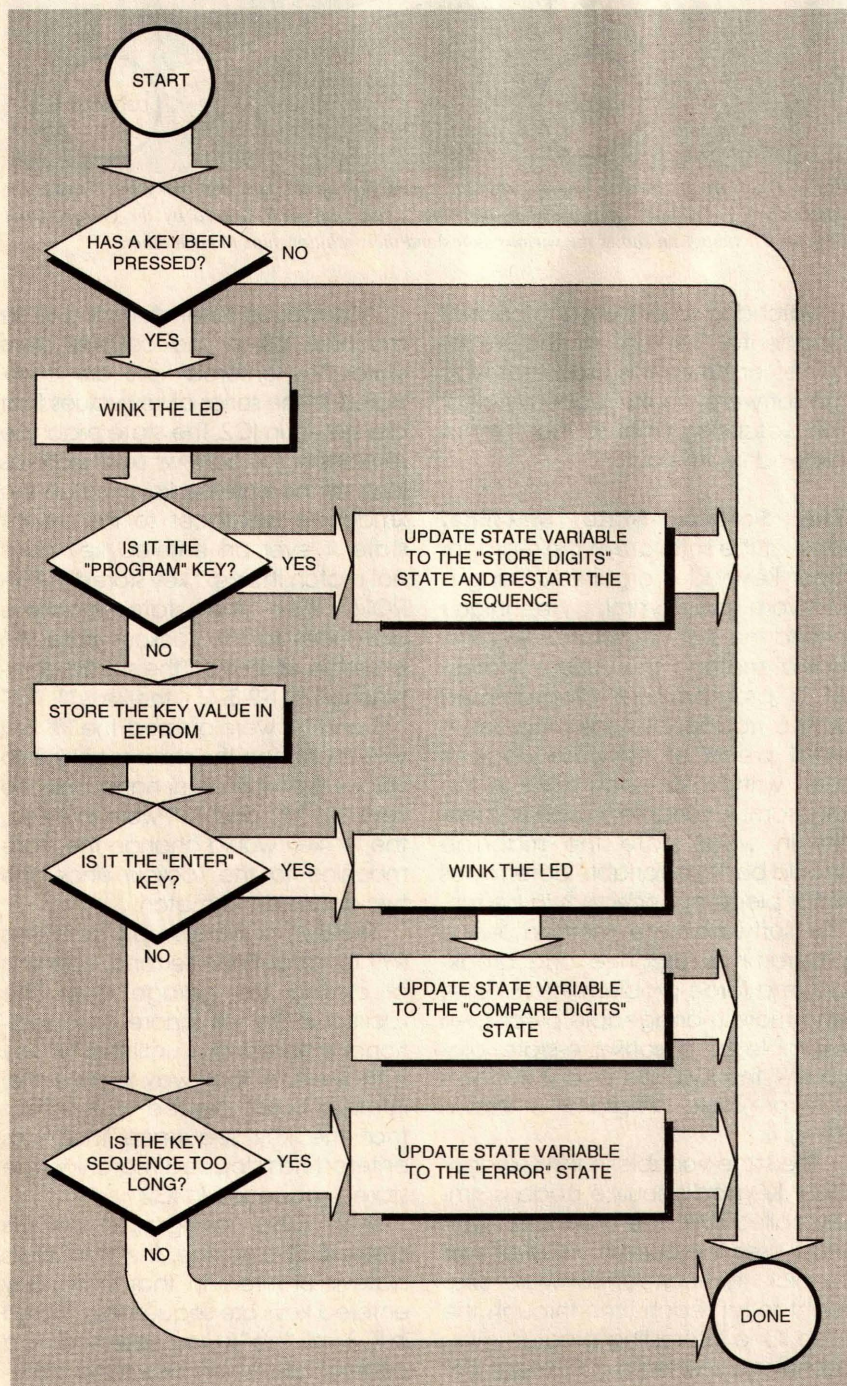


Fig. 5. An example of how the Garage-Door Keypad uses the state-machine concept is shown in this flowchart of the STORE DIGITS state. Note that, like any well-designed state-machine code, the routine is executed only once and exits—it does not loop back to itself.

PARTS LIST FOR THE GARAGE-DOOR KEYPAD

SEMICONDUCTORS

IC1—PIC 16C54-RCI/P microcontroller, integrated circuit
 IC2—93AA46/P serial EEPROM, integrated circuit
 IC3—LT1121CZ-5 5-volt regulator, integrated circuit
 BR1—1-amp, 100-volt bridge rectifier
 D1—1N4148A silicon diode
 LED1—Light-emitting diode, red

RESISTORS

(All resistors are 1/4-watt, 1% metal-film units unless otherwise noted.)

R1—3320-ohm
 R2—4640-ohm
 R3—464-ohm
 R4—10,000-ohm, 10-pin resistor pack, single-inline package

CAPACITORS

C1—100-μF, 35-WVDC, electrolytic
 C2—0.47-μF, 35-WVDC, electrolytic
 C3—0.047-farad or 47,000-μF, 5.5-WVDC, electrolytic
 C4—100-pF, ceramic-disc
 C5—0.1-μF, ceramic-disc

ADDITIONAL PARTS AND MATERIALS

J1, J2—2-contact terminal, screw contact
 RY1—Single-pole, single-throw 5-volt relay (Magnecraft W107DIP-1 or similar)
 S1—Single-pole, single-throw miniature pushbutton switch, momentary action
 S2—12-digit keypad (Digitran KL0054W or similar)

Note: The following items are available from: A and T Labs, Box 4884, Wheaton, IL 60189, Fax: 630-668-7870: etched and drilled PC board, \$15 plus \$3 shipping/handling within US, \$5 shipping/handling outside US; kit of all parts including PC board and water-resistant keypad, \$39 plus \$4 shipping/handling within US, \$7 shipping/handling outside US. Check, VISA, MasterCard accepted. IL residents must add appropriate sales tax.

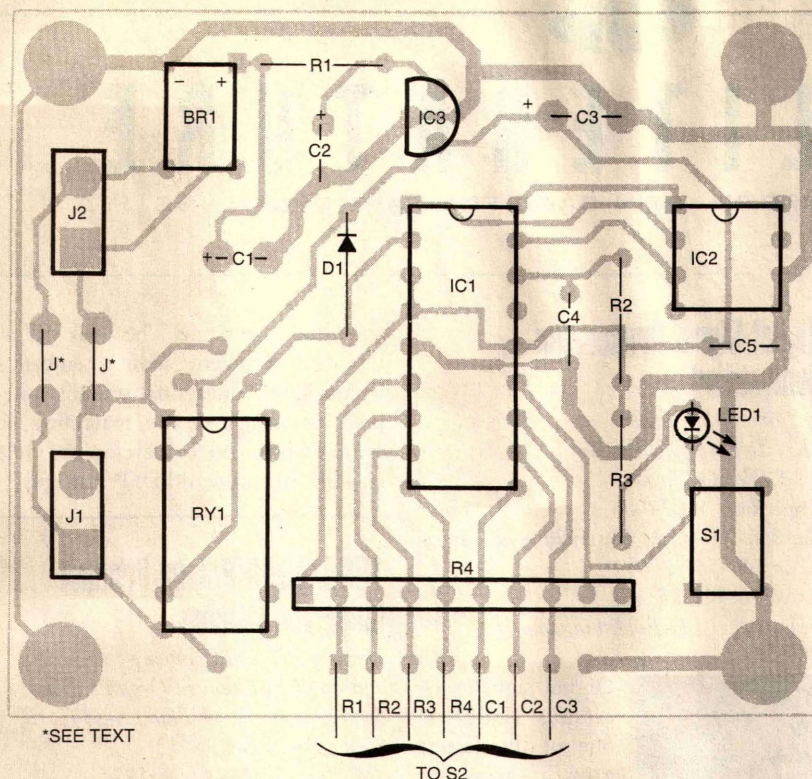


Fig. 6. The Garage-Door Keypad is easily built on a single-sided PC board. If your garage-door opener can supply the current needed to run the Garage-Door Keypad, install the two jumpers; J2 can then be left out as it will not be used. If, on the other hand, you will be powering the unit from an external power supply, leave the jumpers out and connect the power supply to J2. Don't worry about polarity on J2—either AC or DC can be used.

IC1, make sure that it has been programmed with the Garage-Door Keypad software; the PIC chip available from the source given in the Parts List is already programmed.

Install all of the board-mounted components with the exception of the two jumper wires, carefully checking resistor values and com-

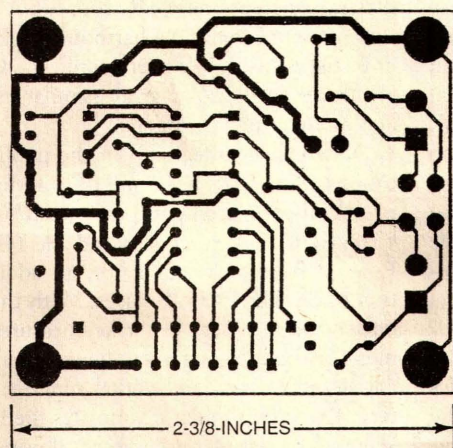
ponent orientations as you work. Temporarily connect keypad S2 as shown in Fig. 1. Using a bench power supply, apply 10 to 24 volts AC or DC through a 1000-ohm resistor in series to J2. Push program button S1; LED1 should light. Enter a short digit sequence followed by the "#" key. Re-enter the same sequence of numbers, again followed by "#" key. With each key press, LED1 should flash. Once you have entered the correct combination of keys, you should hear RY1 operate for about one second.

Wait a few moments and type in a wrong code. Check that RY1 does not operate when the "#" key is pressed; LED1 should continue to indicate key presses. The correct code should not activate RY1 unless the "#" key is pressed before entering it.

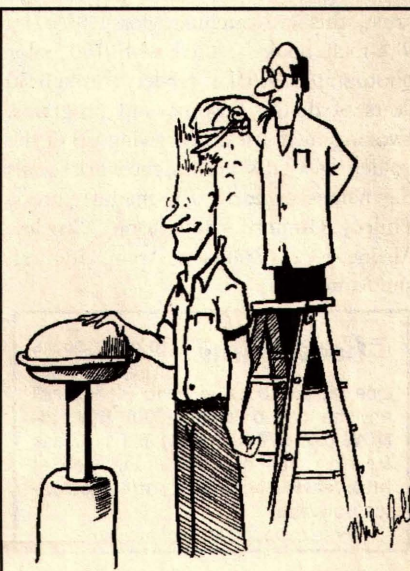
If you will be powering the Garage-Door Keypad directly from the garage-door opener, install the two jumper wires.

Installation. Choose a suitable mounting location for S2. If you are using the suggested keypad, drill four small corner holes that match the mounting studs in the keypad. Drill an additional hole or slot for the ribbon cable. A slot can be cut by either sawing or drilling a series of holes. Thread the ribbon cable through the wall and mount the keypad with a bead of clear silicon rubber inside the back perimeter of the keypad. Run the ribbon cable to the PC board and mount the PC board inside the garage as desired. Connect two wires from J1 to the opener-operating contacts or in parallel with an existing garage-door-operating button inside the garage. If, on the other hand, you cannot power the Garage-Door Keypad directly from your garage-door opener, simply leave out the two jumpers on the board and connect J2 to a wall transformer that supplies from 10 to 24 volts, AC or DC.

Other Applications. You can easily use the Garage-Door Keypad for keyless operation in a variety of other applications; the uses are limited only by your imagination. If those other applications are not able to power the Garage-Door Keypad as described above, then you can simply leave out the jumpers and power the board from a DC or AC power source that supplies from 10 to 24 volts. Less than one milliamp of current is needed by the Garage-Door Keypad. Ω



Here's the foil pattern for the Garage-Door Keypad. The simple circuit fits nicely on a small single-sided board.





NEW LITERATURE

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

The Golden Age of Televisions

by Philip Collins

General Publishing Group, Inc.
2701 Ocean Park Blvd., Suite 140
Santa Monica, CA 90405
Tel: 310-314-4000
Fax: 310-314-8080
\$15.95



CIRCLE 338 ON FREE INFORMATION CARD

Whether they are 45-inch monstrosities or 2- by 2-inch pocket pals, today's televisions display a uniform slickness.

In this book, the author presents a time when televisions were virtually works of modern industrial art—from the smallest screen and futuristic designs that never quite took off to wooden cabinets rivaling the finest of fine furniture.

Through words and images, Collins—a noted visual historian—explains the important role these televisions played in our culture and their social relevance. They were the center of every home. This 120-page journey through nostalgia is not only for collectors and historians, but also for anyone who loves TV.

Designed by Kosh, a pop-culture artist, this eye-catching glossy 8 1/2- by 9 1/2-inch book is filled with 100 color photographs. It takes readers through 70 years of design, history, and programs. Evoking memories of growing up in the golden age of TV heroes, the work recalls the names of early TV manufacturers: Philco, Dumont, Silvertone, Crosley, Airline, RCA, Emerson, Arvin, Admiral, and Motorola.

BooksNow

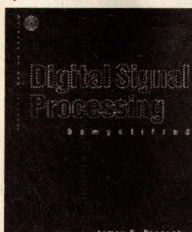
To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronics-now.htm>.

Free catalogs are not available.

Digital Signal Processing Demystified

by James D. Broesch

LLH Technology Publishing
3578 Old Rail Road
Eagle Rock, VA 24085
Tel: 800-247-6553 (for credit card orders)
or 540-567-2000
Fax: 540-567-2539
Web: www.LLH-Publishing.com
\$49.95



CIRCLE 339 ON FREE INFORMATION CARD

Digital signal processing (DSP) is one of the fastest growth areas in electronics, making its way into everything from surveillance satellites to talking toys. This book is a readable, practical tutorial that focuses on the design-oriented information needed by working engineers.

The 232-page book is accompanied by a CD-ROM containing the DSP Calculator suite of educational software routines that interactively illustrate the fundamentals of DSP. The tools included with the DSP Calculator enable the student to create waveforms, design filters, filter the waveforms, and display and analyze the results. The book and the software, which is designed to run under Windows 3.1 or 95 on a minimal 386 system with at least 4 MB of RAM, work hand-in-hand to bridge the gap between theory and engineering design practice. Together they create a "virtual laboratory" for experimenting with basic DSP principles. The purpose of this volume is to give readers both practical knowledge and a sound foundation.

Topics covered include components of a DSP system, the mathematical basics underlying DSP, sampling theory, the Fourier series, orthogonality and quadrature, transforms, FIR filters, IIR filters, and DSP tools. Although the book is written for engineers, the mathematics is kept

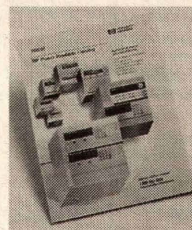
as simple as possible. The book will also be useful to students about to embark on formal DSP educational training and to program managers and marketing personnel who need to develop an understanding of real-world DSP concepts.

1998/1999 Power Product Guide and Catalog

Hewlett-Packard Company

Test and Measurement Organization
5301 Stevens Creek Blvd., MS54LAK
Santa Clara, CA 95052
Tel: 800-452-4844, ext. 5921
Web: www.hp.com/go/power

Free



CIRCLE 340 ON FREE INFORMATION CARD

The 16-page Guide (Literature No. 5966-1707) contains a concise overview of Hewlett-Packard's power product line, highlighting key features and specifications. In addition, the 65-page Catalog (Literature No. 5966-1706) provides R&D and production engineers with complete technical information on more than 125 models of dynamic measurement DC sources, AC power source/analyzers, harmonic/flicker test systems, DC power supplies, DC electronic loads, solar array simulators, and modular power systems.

New products featured in the publications are the HP 6610 and 6630 series precision-measurement single-output system DC power supplies and the HP E4351B solar array simulator, an addition to the HP E4350B series. With the power supply, users can take measurements without having to configure external shunts, relays, and digital multimeters. The solar simulator simulates the I-V curve of solar rays accurately, allowing test engineers to perform satellite testing with greater precision and efficiency.

(Continued on page 60)



NEW PRODUCTS

USE THE FREE INFORMATION CARD FOR FAST RESPONSE

"Heads-Up" Digital VOM

DESIGNED FOR INDUSTRIAL AND residential electricians, the VisualEYEzer uses "heads-up" technology to project the VOM display in front of the user's right eye. Always in sight—no need to look away to get a reading—this display feature allows the electrician to use both hands to do testing.

The two-piece system consists of a belt pack and a headset that is optically isolated from it. Connected to the belt pack by a breakaway cable, the lightweight headset comes with an adjustable, padded headband. Resembling a typical fanny pack, the belt pack is made of rigid black plastic. Its sloped top panel displays the pack's only controls—an on/off slide switch and contrast- and loudness-up and -down pushbuttons.

Readings are taken from the belt pack and displayed on the headset. The latest model of the VisualEYEzer features a more rugged eyepiece with a 20% larger viewing surface. An adjustment arm has been added for positioning the eyepiece to keep it fingerprint free, and an adjustable friction hinge keeps the eyepiece in place.

The viewing lens is a transparent, semi-silvered mirror that projects the red, 4000-count display and annunciators, which are quite readable—even in low-light areas. The image appears to float at a comfortable 18 inches in front of the user's right eye and permits unobstructed vision of whatever else the viewer is seeing.

Two different eyepieces are available: one for indoor use (supplied) and the other (optional) for use outdoors or in bright conditions. Lenses can easily be changed in less than 30 seconds.

Voltage ranges have been extended to 600 volts for work on 480-volt AC lines. Each newly designed test probe tip now contains a high-energy 1-amp/600-volt-



CIRCLE 20 ON FREE INFORMATION CARD

rated BBS fuse that prevents damage from going any further than the probes when a fuse blows.

Two multifunction pushbuttons located on the test probes replace the traditional range and function controls. These pushbuttons allow the user to change ranges and functions without looking away from the unit under test. Pressing the black probe pushbutton selects the desired function. Pressing the red probe pushbutton changes the range. Simultaneously, the display cycles through the different LED annunciators, indicating the function or range selected.

The VisualEYEzer comes complete with belt pack and adjustable web belt, headset and padded headband, 60-inch fused test leads, screw-on alligator clips, connecting cable, indoor eyepiece assembly, and instruction manual. It is conveniently stored in a hard-sided, foam-lined carrying case and is powered by four C-cell alkaline batteries or by the included AC power supply. Its list price is \$369.

TRIPLETT CORP.

One Triplett Drive

Bluffton, OH 45817

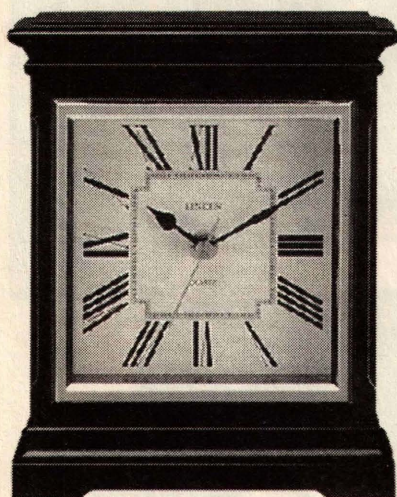
Tel: 800-874-7538 or 419-358-5015

Fax: 419-358-7956

Web: www.triplett.com

Surveillance Clocks

THE TWO LATEST I-SPY CAMERAS from American Innovations, Inc., the MC-985 Mahogany Clock Cam (7 inches wide by 8 inches high) shown here and the CL-985 Carriage Clock Cam (4 inches wide by 5 inches high), blend into any home or office setting. Ideal for surveillance operations, each clock covertly conceals a color video camera with a horizontal resolution of 380 lines and a super low 2-lux sensitivity rating. Each camera also has built-in backlight compensation, enabling it to function in a room with minimal lighting. The custom-designed pinhole lens offers a 92-degree viewing field through an opening that measures only 2mm.



CIRCLE 21 ON FREE INFORMATION CARD

Since the cameras use standard video signals, they can be connected to the TV or VCR. Users can set the timer function on the VCR to check an area at predetermined times and/or intervals.

The clock cameras can be used in the office to monitor the performance of employees. They can be placed in a store to protect merchandise and prevent losses. These cameras are also perfect for working parents who want to keep an eye on the nanny and/or housekeeper while they are away at work. The special introductory price for these two I-spy color clock cameras is \$350 each.

AMERICAN INNOVATIONS, INC.

119 Rockland Center, Suite 315
Nanuet, NY 10954
Tel: 914-735-6127
Fax: 914-735-3560
Web: www.spysite.com

Continuity Tester

DESIGNED SPECIFICALLY FOR the electronics manufacturing industry, the Short Finder Brush (SF 10) is a high-speed continuity tester that eliminates the tedious, time-consuming, point-to-point testing method. The continuity tester's ergonomic design (8.4- x 1.3- x 1-inches) makes it ideal for every day use by personnel in electronics and PCB manufacturing and in production testing; by field service engineers; and by electronics, telephone, electronic service/repair, and field installation technicians.



CIRCLE 22 ON FREE INFORMATION CARD

The Short Finder Brush is used by holding the reference probe in contact with the point of test, and then sweeping the circuit with the low-voltage stainless steel brush-tipped probe until continuity is localized by an audible tone. The search probe identifies the actual point of continuity by conducting a point-to-point search within the area previously identified by the brush. Low-test voltage, which is limited to 0.5 volts DC at 100 μ A, protects sensitive circuitry and eliminates false continuity indications.

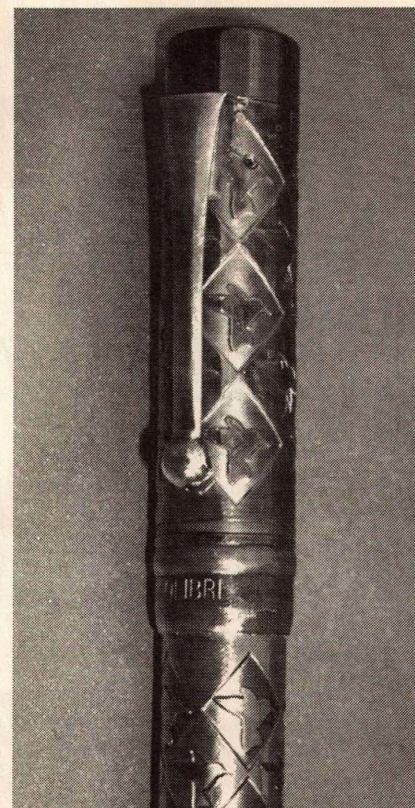
The brush probe allows technicians to sweep over multiple test points and instantaneously find the location of shorts in complex electrical circuits, such as printed circuit card assemblies, multi-conductor cables, mass termination systems, backplanes, connectors, and IC sockets. Two AAA batteries provide portable operation. The Short Finder Brush (SF 10) has a list price of \$35.95.

WAVETEK CORP.

9405 Balboa Avenue
San Diego, CA 92123
Tel: 800-854-2708 or 619-279-2200
Fax: 619-450-0325
Web: www.wavetek.com

Undercover Pen

LOOKING LIKE AN ORDINARY pen in your pocket, the VP-300 Color Video Pen Camera has a micro-miniature color CCD camera hidden inside.



CIRCLE 23 ON FREE INFORMATION CARD

Though small, the unit delivers excellent picture quality. Images can be recorded by using a standard portable video recorder or by being fed into a video transmitter for remote time recording and/or observation. Perfect for law-enforcement operations, private investigators, and undercover news reporters, this unit is a revolutionary way to record live events that require the utmost discretion.

The VP-300 Pen boasts a TV resolution of over 330-line horizontal lines, a low 2-lux sensitivity, and the ability to capture video in low-light settings. Its 3.6mm- pinhole lens delivers a field of vision of 92 degrees. This pen protects your next undercover assignment by making sure that everything is caught on tape.

Optional components (Sony 8mm-video recorder and battery pack) fit neatly into a small waist pack. Since there is no cumbersome video equipment to carry, this easy-to-use unit will always be kept close to hand. Set up takes only a few seconds.

The VP-300 sells for \$2400.

AMERICAN INNOVATIONS, INC.

119 Rockland Center, Suite 315
Nanuet, NY 10954
Tel: 914-735-6127
Fax: 914-735-3560
Web: www.spysite.com

Optical Rangefinding, The Right Way to Measure AC Power, and More

FROM THE NUMBER OF INFOPACK QUERIES I GET ON THE TOPIC, AN ABILITY TO EXACTLY MEASURE SHORT DISTANCES IS VERY MUCH IN DEMAND. AS IT TURNS OUT, THERE IS ONE HIGHLY EFFECTIVE, EMINENTLY USABLE, AND LITTLE-KNOWN

static optical rangefinding DX technique. Let's take a look at it.

Position-Sensitive Detectors

Look way on down the street. Now look at the tip of your nose. Do you see how your eyes tilt inward to view a closer object? That principle is the basis of the parallax distance measurement method shown in Fig. 1A.

You probably also know this as the split-image method, commonly used in military spotting and better-grade cameras. If you know the baseline width and the tangent of the inward tilting angle, you calculate distance by using:

$$\text{distance} = \text{baseline} \times \tan\theta$$

Your results can be quite accurate close in, but get progressively worse as the angle nears ninety degrees and its tangent approaches infinity. The trick is to come up with some method that uses parallax but has no moving parts. The secret to doing that lies in Fig. 1B.

Shine some infrared light on an object; use a laser for accuracy or a plain LED in a cheaper system. Focus the returned light on a special semiconductor device. The position of the light should move from right to left across the device as a function of the distance. Measure position to sense distance.

Now your "special semiconductor device" could be nothing but a pair of side-by-side IR photodiodes. But it turns

out there are position-sensitive detector chips that do a better job.

There is one inside trick: How do you make the system respond only to the position of the reflected light and not to the intensity? Simply by use of normalizing. Let L be the intensity returned by the left side of the sensor and R be the intensity returned by the right side of the sensor. Then you can go ahead and calculate:

$$\text{position} = (L-R)/(L+R)$$

This returns an "amount of offset" independent of the actual strength of the light. The offset is then related to distance as a tangent function. Yes, the division is hard to do in the analog world, but is no big deal digitally.

Sharp Optoelectronics has a nice GPD2D02 chip that can do all the work. Details are shown in Fig. 2. Arrange the optics so the reflected infrared light moves across the chip as a function of distance. The built-in IR diode pulses your target. The return image traverses its internal position-sensitive detector.

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher AZ, 85552
Tel: 520-428-4073

US email: don@tinaja.com
Web page: <http://www.tinaja.com>

Goodies in the chip do the needed difference sensing, A/D conversion, and DSP.

The output is a serial 8-bit digital number. That number is easily related to distance using a calibration curve and table lookup. A Basic Stamp or a PIC is ideal to gather and display the range information. See the Sharp data sheet for timing and readout information.

The measurement cycle takes 70 milliseconds, followed by eight clock pulses of 0.2 milliseconds maximum and a stop pulse of 1.5 milliseconds. The effective range of this chip is 8 to 120 centimeters, or roughly three to forty inches. The supply current is 17 milliamps operating and 8 milliamps standby on a 5-volt supply.

A few obvious uses include camera autofocus, parking-lot or garage auto obstacle avoidance, and auto-power for hand dryers. Plus, of course, there are scads of close-in robotic-sensing apps.

The chips work best with *specular* or diffuse reflection. Yes, any hot spots could be a problem. But the infrared system is largely color independent. Fancier techniques can be added if other ranges are needed.

Sharp also has announced the GPD212 analog and GPD215 digital devices. Those are stand-alone and need no external computer control. They also offer PD3101 and PD3151 detector PSD chips that they intended for camera auto-focus uses. One competitor is Hamamatsu with their S4282-11 and S4282-72 devices. A second alternate PSD supplier is Ricoh.

One source for further PSD information is SPIE, also the Society of Photo Optic Engineers. Their *Proceedings #2002* on Photodetectors and Power Meters is one possible starting point. A PSD fundamentals tutorial can be found at www.nts.mh.se/~johma/psd

new from DON LANCASTER

ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **\$28.50**

RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. **\$79.00**

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. **THE** two books for digital integrated circuit fundamentals. About as hands-on as you can get. **\$28.50** each.

INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **\$18.50**

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **\$119.50**

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
PostScript Video & secrets	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **\$39.50**

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. **28.50**

BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **\$24.50**

RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **\$24.50**

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: don@tinaja.com
FREE US VOICE HELPLINE VISA/MC

SYNERGETICS
Box 809-EN
Thatcher, AZ 85552
(520) 428-4073

A really great FAQ on just about everything involving LEDs can be downloaded at the www2.whidbey.net/optinfo/LED_FAQ.html site. I have got a detailed custom InfoPack available on optical rangefinding; see www.tinaja.com/info01.html

Another Look at AC-Power Measurement

Until quite recently, it had been very difficult to accurately measure AC power. Especially in the presence of any strange waveshapes, reactive energy, noise, or sparking. Nearly all casual measurements tend to end up low, often ridiculously so, leading to all sorts of pathetic claims that relate to circuit "efficiencies" and to "overunity" operation.

All average-responding voltmeters and

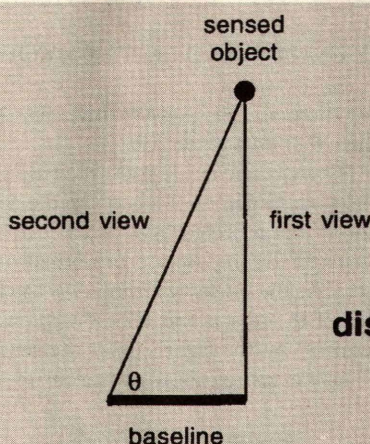
ammeters are useless for much of real world power measurement. So is staring at some oscilloscope without having the foggiest clue what you are looking at. All of which leads us to beginning EE student blunder #01-A—that of confusing average and rms voltage or current.

We've done a bit on this, but I'd like to return to this topic one more time, hitting it from a slightly different angle. We'll start with these fundamental rules:

$$\text{instantaneous power} = \text{instantaneous voltage} \times \text{instantaneous current}$$

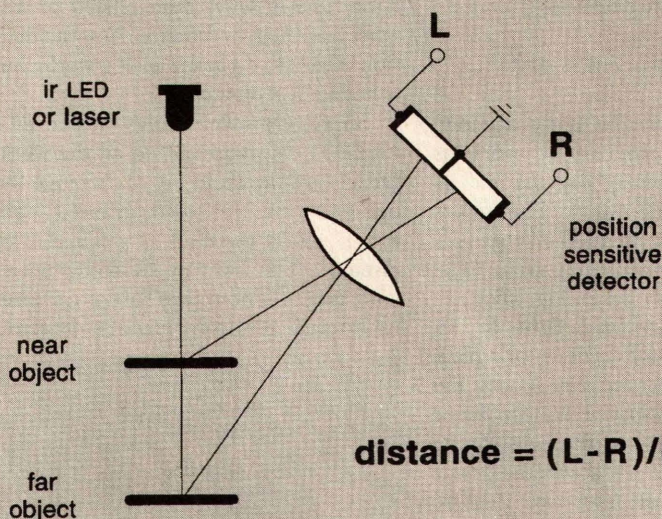
and

$$\text{efficiency} = (\text{average power out}) / (\text{average power in})$$



$$\text{distance} = \text{baseline} \times \tan \theta$$

(A) Dynamic parallax or "split image" method.



(B) Static Position Sensitive Detector method.

FIG. 1—HERE ARE TWO METHODS of optical rangefinding. Basic parallax rangefinding is shown in A, while B shows a method that uses electronics and no moving parts.

The latter will always be a number from 0 to a tad under 1. That value often is multiplied by 100 to get a percent efficiency from 0 to 99.9. The losses will almost always be in the form of low-grade heat.

Any efficiency above 100% is experimental error. Or (in the case of a heat pump) does not account for all of the energy inputs. This is true every time and without exception.

Suppose you have a box with two terminals on it. Make a very brief and a simultaneous measurement of your voltage and the current. Make sure that your measurement is brief enough that neither one changes much during your measurement time, and clean enough that noise will not be a factor. Accurately multiply the voltage and current values together to get your instantaneous power. Sum these over time and then divide by the number

of samples to get average power.

If the voltage and current samples are both positive or both negative, then your box is acting as a load. The box should be getting hot, adding to its internal E and H energy fields, doing work, or otherwise converting energy into some other form.

If measured voltage and current have opposite signs, your box acts as a source. Your box is cooling down, removing strength from its internal energy fields, is being mechanically worked upon, or otherwise should be converting energy from other inputs into output electricity.

Sometimes a box might cyclically accept energy and then later return it, which happens when internal electric or magnetic fields are getting bigger or smaller. We refer to this back-and-forth process as reactive energy. All reactive power will average to zero over the long term.

Because of reactive energy, an AC motor will typically act as a load for most of the time, but as a source for the remainder. We did see examples of this back in MUSE123 (May 1998 issue of **Electronics Now** or on my Web site).

For accurate results, you multiply first and average last. Why? Because average first and multiply last almost always gives you low results. Also remember that the average of products is not the same as the product of averages!

Playing With Blocks

Suppose you have four wooden blocks. Each block is labeled as 1.0 amp of current high and 0.25 second of time wide.

Suppose further that you've got a time bin that is one second wide. Should it matter how you pile your blocks into your bins? Can the exact arrangement of the four blocks affect your circuit power?

Assume a 1-ohm resistive load for now. Later on, the type and size of load will not matter.

In Fig. 3, we first place all four blocks side by side. The average current is obviously 1 amp. The energy in your first quarter second will be 0.25 watt seconds. The energy in quarters two through four should also be 0.25 watt seconds. Your total energy will be one watt second, and the average power will be one watt.

So far, so good. If we replaced our blocks with a continuous block that had equivalent heating power, it also would result in an average current of one amp and an average power consumption of one watt.

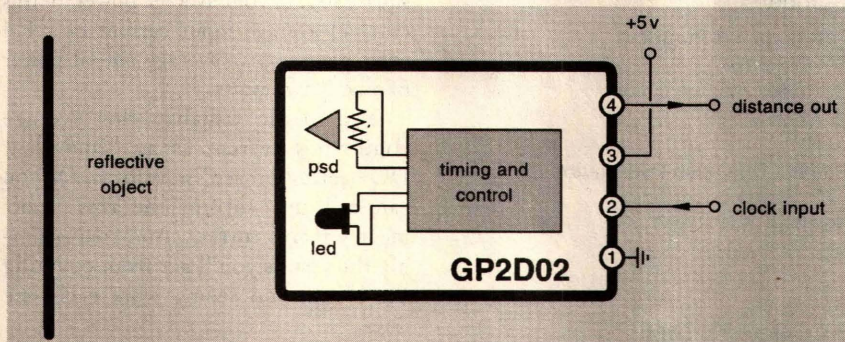


FIG. 2—THIS POSITION-SENSITIVE DETECTOR (PSD) module with no moving parts from Sharp accurately measures short distances.

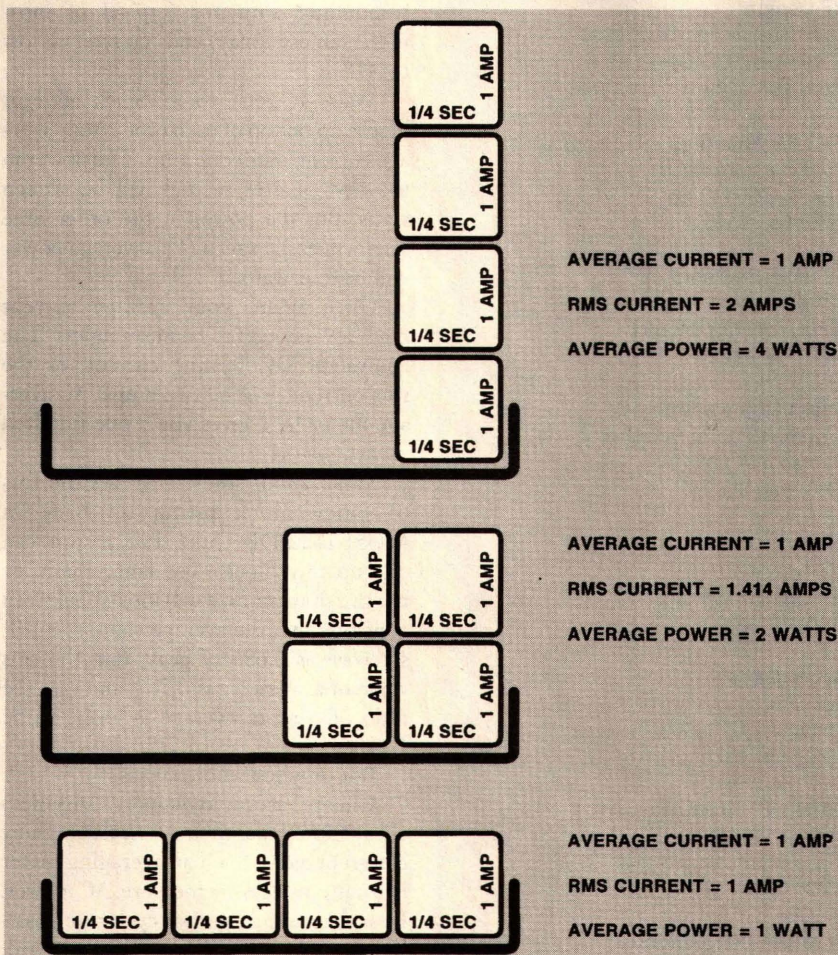


FIG. 3—THE SHAPE OF A WAVEFORM very much determines its average power. Average current (common to most meters) is meaningless for most power measurements. This is a common beginner's mistake.

Now stack your four blocks up two high, and an amazing thing happens. You still have one amp of average current, because we have two amps for half a second and zero amps for half a second. But during your active half second, either the input voltage had to double or else the circuit load resistance halved. Using our above formula, the power in the first quarter second will now be two watts.

The power in your next quarter second should also be two watts. The power in the third and fourth quarter seconds should be zero. The average power should be *two* watts!

Hmmm. In one group, a one-amp average current gives us one watt of average power. In the second, a one-amp average current will give us two watts of average power.

Average current is meaningless when calculating power. We instead have to find out what continuous equivalent current would give us the identical average power.

Well, our power turns out to be current squared times load resistance for a resistor. Or input current times input voltage for any load. Done either way, your equivalent DC continuous current needed turns out to be related to the square root of your average power. In this case, an average input current of 1.414 amps gives you an average output power of exactly two watts.

You might visualize this average continuous current as an "equivalent DC heating power" waveform. Or you can call this current the rms (root-mean-square) current. And rms is simply the results you'll get from counting the blocks and seeing what each one does.

Reviewing: The stacked average current will be 1.00 amp, but the rms current is 1.414 amps. Clearly, any average-responding ammeter (typical of most meters in use today) ends up reading low by 41%!

Wait—it gets worse. Stack all four blocks up on top of each other. Your average current is still one amp. The power in the first quarter second will be sixteen watts. But the power in the other time slots will end up zero. The average power will be four watts!

Once again, your average current reads low enough to be meaningless. The equivalent DC heating current, or the rms current, will be two amps. An average meter here gives you a one hundred percent error!

What about sinewaves? We did lots of fancy block piling on back in MUSE112.PDF (June 1997). You can pile up tiny blocks, use fancy math, or use the simulator we will look at below to conclude that the average value of a half sinewave is 0.684 of peak; that the rms value of a sinewave is 0.707; and that the ratio of peak to average is found to be 1.1106.

But only for whole cycles!

Cheap averaging-meter suppliers cheat and relabel their AC scales high by eleven percent. Such an averaging meter is totally useless to measure AC power. First, because of partial cycles or possible strange waveforms. And second, because of reactive currents that place instantaneous voltages and currents out of phase.

Names and Numbers

Amateur TV Quarterly

5931 Alma Dr.
Rockford, IL 61108
(815) 398-2683

Biomass & Bioenergy

PO Box 882
New York, NY 10159
(212) 633-3730

Brand Electronics

421 Hilton Rd.
Whitefield, ME 04353
(888) 433-6600

Dallas Semiconductor

4401 Beltwood Pkwy. S.
Dallas, TX 75244
(972) 371-4000

DuPont

1007 Market St.
Wilmington, DE 19898
(302) 774-1000

Flow Control

84 Park Avenue
Flemington, NJ 08822
(908) 788-0343

Fuel Cell Technology News

25 Van Zant St.
Norwalk, CT 06855
(203) 853-4266

Hamamatsu

360 Foothill Rd.
Bridgewater, NJ 08807
(201) 231-0960

International Rectifier

233 Kansas St.
El Segundo, CA 90245
(310) 322-3331

Loctite Corporation

1001 Trout Brook Crossing
Rocky Hill, CT 06067
(860) 571-5100

MRT/Mobile Radio Technology

PO Box 12901
Overland Park, KS 66282
(913) 341-1300

Paragon Art Products

PO Box 3324
Santa Monica, CA 90408
(310) 264-1980

Phillips Business Information

1201 Seven Locks Rd.
Potomac, MD 20854
(800) 777-5006

Raychem

300 Constitution Drive
Menlo Park, CA 94025
(800) 227-7040

RF Design

5660 Greenwood Blvd. #350
Englewood, CO 80111
(303) 793-0448

RMT Engineering

6863 Buffham Road
Seville, OH 44273
(330) 887-5535

Sensory Systems

521 E. Weddell Dr.
Sunnyvale, CA 94089
(408) 744-9000

Sharp Optoelectronics

5700 NW Pacific Rim Blvd.
Camas, WA 98607
(360) 834-2500

SPIE

PO Box 10
Bellingham, WA 98227
(206) 676-3290

Synergetics

Box 809
Thatcher, AZ 85552
(520) 428-4073

United Controls

1554 Litton Drive
Stone Mountain, GA 30083
(770) 496-0884

Wireless Integration

10 Tara Blvd. 5th FL
Nashua, NH 03062
(603) 891-0123

Summing up: The average power depends upon the duty cycle and the shape of the waveform involved. One proper way to measure your average power is to take many narrow voltage and current samples. You multiply your samples

together to find instantaneous power, sum the samples to get accumulated power, and divide by the number of samples to get average power. This needs to be carefully done over either a very long time or an integer number of full cycles.

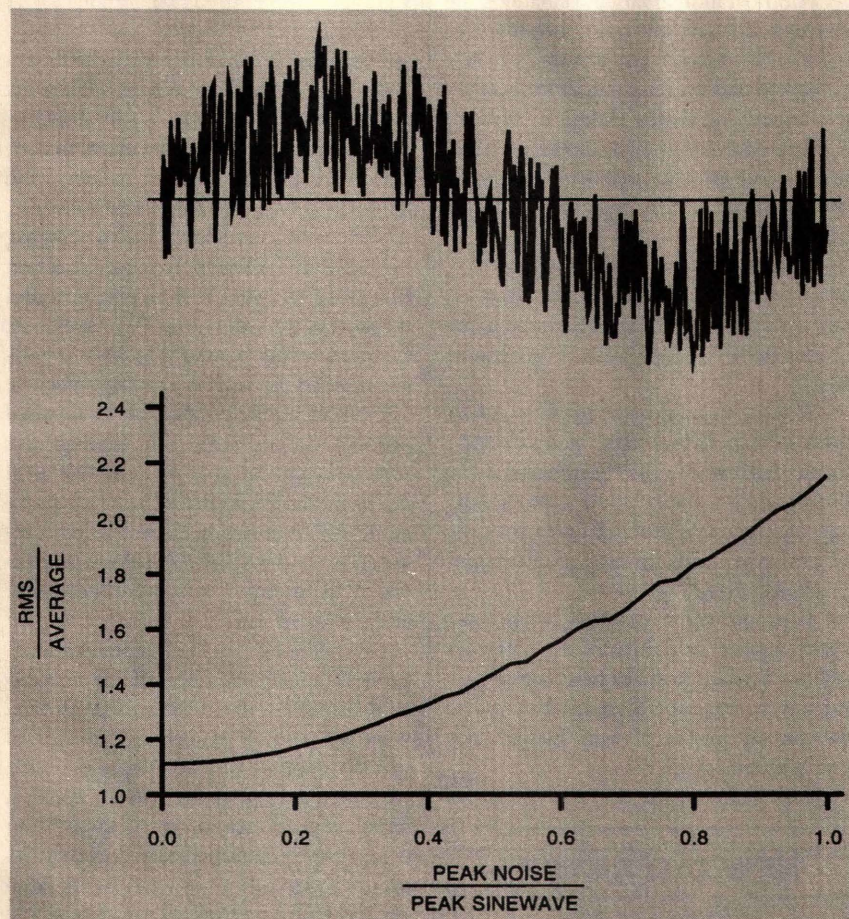


FIG. 4—ADDING NOISE to a sinewave increases the energy and raises its rms to average ratio. Noisy systems often lead to wildly wrong conclusions about power and efficiency, and to outrageous "overunity" claims.

Some Error-Correcting Code Books

Principles of Digital Communication (Andrew Viterbi)
1997 Error Correcting Code Symposium (Harold Mattson)
Algebraic Algorithms and Error-Correcting Codes (John Alton)
Applicable Algebra Error-Correcting Code Algorithms (Beth, Th.)
CDMA; Principles of Spread Spectrum Communications (Andrew Viterbi)
Coded Modulation for Fading Channels (Hamidreza Jamali)
Data & Computer Communications (William Stallings)
Engineer's Error Coding Handbook (A Houghton)
Error Correcting Codes (John Baylis)
Error Control Coding (Shu Lin)
Error Control Systems for Digital Communications (Stephen Wicker)
Error Control Techniques for Digital Communications (Arnold Michelson)
First Course in Coding Theory (Raymond Hill)
Introduction to Error-Correcting Codes (Michael Purser)
Introduction to Error Correcting Codes (Scott Vanstone)
Introductory Theory of Error-Correcting Codes (Vera Pless)
Theory & Applications of Error-Correction Codes (Jiri Adamek)
Trellis Coding (Christian Schlegel)
Voice & Data Communications Handbook (Regis Bates)
Understanding Data Communications (Gilbert Held)

Since analog multipliers get into severe crest factor problems, digital is the only way to go here. A number of effective low-cost AC power measurement tools are found at Brand Electronics. And, yes, they easily deal with strange or unusual waveforms. Click their banner link at www.tinaja.com

These days, it is simple enough to use a PIC and simultaneous A/D chips like the Maxim MAX125/126 to make the 12,000 or more minimum samples per second needed to do the job right. Almost any better grade PC data-acquisition plug-in can also be used with appropriate care. Regardless of how you go about things, knowing your precise waveforms is crucial.

What About Noise?

A question came up on the web over what effect noise has on power waveforms. The specific questions dealt with noise caused by the bubbling in a cold-fusion cell or the cavitation in a Griggs pump.

Figure 4 shows what happens if you add random-noise energy to any sinewave. As expected, the ratio of rms to average goes up, causing any average responding meter to further under-report.

By an astounding coincidence, the under-reporting seems to end up the same size as certain overunity claims, proving that free-energy enthusiasts are a source of noise.

Such simulations are both trivial and fun to do using PostScript. These models also let you use simple math to replace fancy calculus and related advanced calculations. I've posted the source code for the simulation and the Fig. 4 artwork at MUSE131.PDF on www.tinaja.com

Error-Correcting Codes

Say you add one bit to a data word designed to always make the number of ones in the word even. Test that bit on reception. Should you have an odd number of ones, then an error likely has occurred. You then can ask for a correcting retransmission.

This is an example of a simple parity check. Now arrange all of your words into blocks. Add parity to row and column. This time, on reception, a row-parity violation and a column-parity violation often can "point" to a problem bit that can be fixed. You've got an error-correcting code.

By looking at fancier combinations of

bits using polynomial math, you can conjure up codes that can correct themselves better and can do so even in the presence of multiple errors. I've gathered together a few of the books on error-correcting code as this month's resource sidebar. The classic text is A. Vitribi's *Principles of Data Communications*, but it is out of print and may be hard to find. More information on these titles is up at www.tinaja.com/amlink01.html

New Tech Lit

From Phillips Business Information comes a free North American Satellite Access wall chart. From Sensory Systems, there are details on a Voice Dialer speech recognition chip intended for telephone uses.

From Dallas, there's a new booklet on Thermal Management chips. They've got some really interesting, accurate, and low-cost chips here. A well-done tutorial on RFID radio frequency identification appeared in *RF Design* for July 98, pp. 38-44.

More details on "pushme-pullyou" Hexapod machine systems that can be amazingly accurate, quite simple, and completely eliminate sliding ways are found at www.i-way.co.uk/~storrs/lme/LMEHexapodMachine.html Some related tutorial information is found at www.tinaja.com/flut01.html

Tech magazine update: Check out the *Amateur Television Quarterly*; the expensive *Fuel Cell Technology News*; MRT, which used to be *Mobile Radio Technology*; *Flow Control* on fluid handling; *Wireless Integration*; and *Biomass & Bioenergy*.

Electronics Bench Reference is a labor-of-love published by Dick Tormet. It is full of useful data. It is available through RMT Engineering.

Low-cost "Cash and Carry" InfoPack consulting services can now be found at www.tinaja.com/info01.html

From Loctite comes a booklet on light-cure technology—adhesives that set up in the presence of strong ultraviolet light. It also has a good review of UV fundamentals. From DuPont comes details on their upgraded Somos 7100 stereolithography resins. These can be used in Santa Claus machines. For other suppliers and background information, see www.tinaja.com/santa01.html

Lots of free samples this month. A large packet of Schottky power diodes is available from International Rectifier; some really good NukeTape silicon-rubber splicing tape from United Controls;

and SiBar thyristor surge protectors from the folks at Raychem.

Wireform is a new flexible screen product from Paragona Art Products. This should have all sorts of mockup and prototyping uses as well.

For most individuals and smaller scale startups most of the time, any involvement whatsoever with patents is nearly certain to end up a net loss of time, energy, money, and sanity. Details in *My Case Against Patents* package, along with my tested and proven real-world alternatives. See my nearby Synergetics ad for full details.

Bunches of surplus test equipment, optics, and robotics bargains are now up at www.tinaja.com/bargte01.html There's even a full PC-board plate-through hole lab.

The latest additions to my Guru's Lair Web site include a free technical user forum; fast "power nav" buttons; more on buying military surplus; tips on finding test-equipment manuals; new typesetting secrets; and some updates on Book-on-Demand publishing.

As usual, most of these mentioned items appear in a Names & Numbers sidebar. Be sure to check here before calling our no-charge US technical help line mentioned in the "Need Help?" box you'll find nearby.

Let's hear from you.

EN

BooksNow

To order books in this magazine or, any book in print. Please call anytime day or night: (800) BOOKS-NOW (266-5766) or (801) 261-1187 ask for ext. 1454 or visit on the web at <http://www.BooksNow.com/electronicsnow.htm>.

Free catalogs are not available.

applications. With more than 1400 test and measurement products, Tektronix provides everything from low-cost instrumentation and handheld products to conventional measurement products and advanced mixed-signal test solutions.

The 700-page soft cover catalog includes a full-color, new product section that features over 70 new products and measurement solutions. Throughout, the catalog highlights ISO 9001-compliant products as well as products meeting CE certification. In addition to detailed product descriptions, the catalog lists tutorials, application notes, and technical briefs. Extensive indexes list products by name and by function, as well as by categories such as oscilloscopes, logic analyzers, VXI systems, telecommunications, and television test.

In addition to the paper catalog, product information is available on CD-ROM and on the Tektronix Web site: www.tek.com/Measurement, both of which contain everything found in the paper catalog, plus the latest updates, news, educational material, application notes, and technical briefs. Information on products on the disk can be updated directly from the Web. Directly from the Web or via CD-ROM access, users can also go to the oscilloscope product selector to choose the right oscilloscope or download the latest software drivers. EN

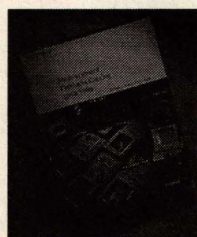
NEW LITERATURE

continued from page 50

Measurement Products Catalog 1998/1999

Tektronix Measurement Business Division
P.O. Box 3960
Portland, OR 97208-3960
Tel: 800-426-2200 (code 1094)
Fax: 503-222-1542
Web: www.tek.com/Measurement

Free



CIRCLE 341 ON FREE INFORMATION CARD

The Measurement Products Catalog includes a broad offering of test equipment, including innovative products such as the Digital Phosphor Oscilloscope (DPO) for design engineering, manufacturing, service, communications, and television test

VIDEO PALETTE

(continued from page 39)

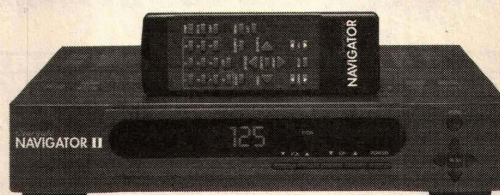
but the bypass switch allows for more flexibility.

Generally, one would not use the effects purely by themselves, but in a mixture with the straight video signal. However, that is a matter of taste, and one's individual preference is neither right or wrong. There is a definite artistic component in both how the effects are best produced and used; no purely technical criteria is necessarily valid in a given case. The best way to get a feel for the best settings is through individual experimentation. Ω

Electronic SHOPPER[®]

THE Ultimate Navigator Series

- Advanced Baseband Replacement
- Interactive On Screen Display
- Remote Control
- 125 Channel Capacity
- Watch One Premium While Recording Another
- Parental Control with timed lock / unlock schedules
- Watch and Record Capability
- Easy Read Clock
- Preloaded Channel Labels
- Unique Favorite Channel Theme System
- Audio/Video Input and Output
- Addressable/Programmable
- Electronic Program Guide Available*



* Also exclusively available STARLIGHT ELECTRONIC PROGRAM GUIDE THE NAVIGATOR SERIES

- One Touch Recording
- Eliminates Complicated VCR Programming
- Current, Future or Series Recording
- Categorizes All Programming
- Displays Time, Date, Rating, Starring Actors, and More
- Seven Day Programming
- Free 90 Day Subscription



Elite Premier

New!

FEATURES OF ELITE PREMIER

- Volume Control
- Audio/Video Out
- Slim Line Remote
- 800 MHz / 125 Channel
- Parental Control
- Unlimited Favorite Channels
- STD/HRC/IRC Switchable
- Manual Fine Tuning
- Manual Tune Override
- Automatic Fine Tuning

Elite 800

Prices Too Low to Print!



Stargate Infinity 3000A

SHARP'S™ NEW PREMIUM DYNAMIC TUNER

- NO OTHER CABLE BOX GIVES A SHARPER PICTURE

- Upgradeable Micro Card
- 125 Channel / 800 MHz
- Volume Control
- Audio/Video Outputs
- Sleep Timer
- Parental Control
- Dynamic Memory Recall
- Automatic Low Signal Enhancer
- Last Channel Recall
- Unlimited Favorite Channels
- Slim Line Remote
- Automatic Fine Tuning

VIEWER'S CHOICE ELECTRONICS

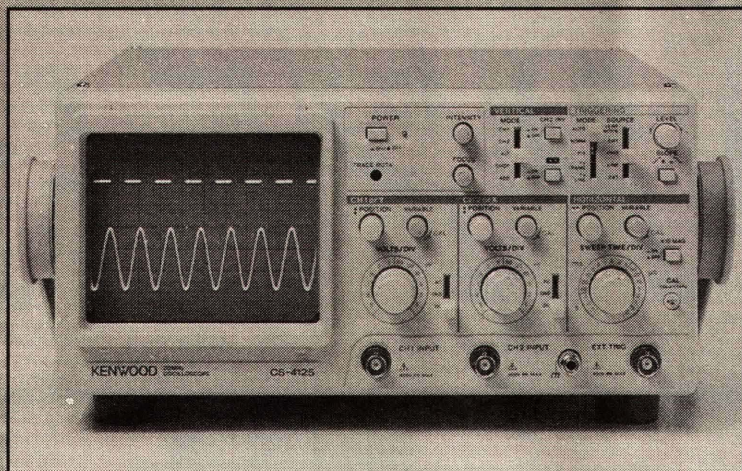
5337 SOUTH CAMPBELL AVENUE, SUITE A2, SPRINGFIELD MO 65810

800-228-7404 FAX 417-887-2883

www.viewerchoice.com

KENWOOD

*...from the company you've
been listening to for years...*

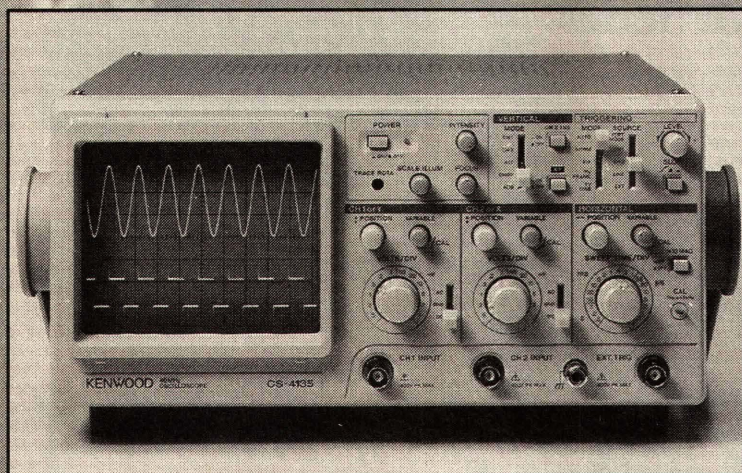


2-Channel, 20-MHz

CS-4125

Regular \$595

Sale \$389



2-Channel, 40-MHz Oscilloscope

CS-4135

Regular \$855

Sale \$685

Hybrid IC Technology is the Key to the High Quality and High Reliability at Low Cost!

- **FIX SYNCHRONIZATION** detects the trigger level automatically for the acquisition of stationary waveforms without complicated sync level adjustments.
- **VERT MODE TRIGGERING** enables the acquisition of stationary waveforms for both CH1 and CH2 even when the input signals to the two channels have different frequencies.
- **HIGH WITHSTAND INPUT** voltage of 400V (800Vp-p).
- **RELAY ATTENUATORS** are provided for reliable logic switchover.
- **SCALE ILLUMINATION** (CS-4135 only)
- **DIMENSIONS** (WxHxD): 300(343) x 140(150) x 415(430)mm () including protrusion.
WEIGHT: approx. 7.2kg (CS-4135) approx. 7kg (CS-4125)



PRINTTM
Products International

*Call for your free 84 page test instrument catalog today!!!
8931 Brookville Road * Silver Spring, Maryland * 20910*

** Phone 800-638-2020 * Fax 800-545-0058 * www.prodintl.com*

RAMSEY



World's Smallest TV Transmitters

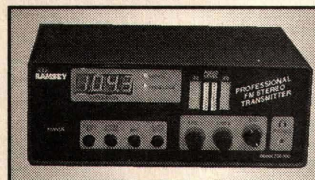
We call them the 'Cubes'.... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies—that's a nickel in the picture!



Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

- C-2000, Basic Video Transmitter Cube.....\$89.95
- C-3000, Basic Video and Audio Transmitter Cube.....\$149.95
- C-2001, High Power Video Transmitter Cube.....\$179.95
- C-3001, High Power Video and Audio Transmitter Cube.....\$229.95

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require

a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply.

We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

- FM-100, Professional FM Stereo Transmitter Kit.....\$299.95
- FM-100WT, Fully Wired High Power FM Transmitter.....\$429.95

AM Band Radio Transmitter



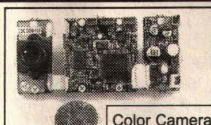
Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

- AM-25, Professional AM Transmitter Kit.....\$129.95
- AM-1, Entry level AM Radio Transmitter Kit.....\$29.95
- CAM, Matching Case Set for AM-1.....\$14.95

CCD Video Cameras



B&W Camera



Color Camera

If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

- CCDWA-2, B&W CCD Camera, wide-angle lens.....\$99.95
- CCDPH-2, B&W CCD Camera, slim fit pin-hole lens.....\$99.95
- CCDPH-2, Color CCD Camera, wide-angle lens.....\$149.95
- IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
- IB-1, Interface Board Kit.....\$24.95

FM Stereo Radio Transmitters



Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio

quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

- FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.

- FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95
- CFM, Matching Case and Antenna Set.....\$14.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

- LPA-1, Power Booster Amplifier Kit.....\$39.95
- CLPA, Matching Case Set for LPA-1 Kit.....\$14.95
- LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95

Treasure Finder Kit



Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object.

Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

- TF-1, Treasure Finder Kit.....\$39.95

Binocular Special

We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight



aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for \$30 more!

- BNO-1, Binoculars and case.....\$24.95
- BNO-1EX, Ruby Coated Lens Binoculars and case.....\$29.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems, hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

- SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95
- CSS, Custom Matching Case and Knob Set.....\$14.95
- SS-70AWT, Fully Wired SS-70A with Case.....\$79.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

Call for our Free Catalog !

See our complete catalog and order on-line with our secure server at:
www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, order status at this number

Technical Info, Order Status
Call Factory direct: 716-924-4560

Fax: 716-924-4555



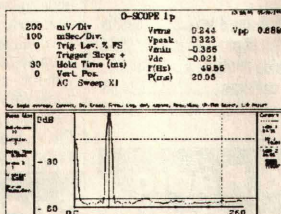
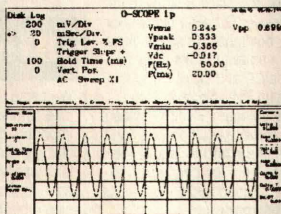
ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

DIGITAL STORAGE OSCILLOSCOPES

WITH
SPECTRUM
ANALYZER,
DVM, FREQ.
COUNTER,
AND DATA
LOGGER.

from
\$189.

PORTABLE
MODULES
CONVERT PC'S
INTO
MULTIPURPOSE
TEST AND
MEASURING
INSTRUMENTS.



Why lug a scope around? Toss one of our modules into your laptop case or tool kit. For a multi-purpose test device, plug to a PC parallel port and use the PC screen. Continuous, delayed, or triggered sweeps can be frozen on the screen, printed out, or saved to disk. Frequency Spectrums DC to 25 MHz.

Allison now provides PICO TECHNOLOGY Ltd. portable test equipment, including high-speed scopes, and multi channel data loggers. Pico and O-Scope modules accept standard probes and work with 286 or faster PC's.

FEATURES:

- ♦ PORTABLE UNITS TO 25 MHz
- ♦ USES PRINTER PORT
- ♦ USES STD. PROBES

OPTIONS:

- ♦ PROBE SETS
- ♦ AUTOMOTIVE PROBES
- ♦ BATTERY PACKS
- ♦ SOFT & HARD CASES

O-Scopes Made in U.S.A.

Picos Made in U.K.

Same Day Shipping
Includes Cable, Software & Manuals

O-Scope Ip (DC-50KHz, single trace)\$189.
O-Scope II (DC-500KHz, dual trace)\$349.
PICO (ADC 200/20) (DC-10MHz, dual trace) CALL
PICO (ADC 200/50) (DC-25MHz, dual trace) CALL
PICO pc based data loggers from \$99.

Shipping within U.S. UPS Ground \$7.50(Second day \$11.50)

SEND CREDIT CARD INFO., M.O., or CHECK, OR CALL

1-800-980-9806

Allison Technology Corporation

2006 FINNEY-VALLET, ROSENBERG, TX 77471
PHONE: 281-239-8500 FAX: 281-239-8006

<http://www.atcweb.com>

ONLY COOL-AMP SILVERPLATES ON THE JOB.

From a customer testimonial:

"Ok, your edge connectors don't connect. Or you want to plate your own PC creations, but you don't want to bother with electro-plate solutions. The plating on the socket...has worn off and no longer makes reliable contact...what are you going to do now?"

"Give the people at Cool-Amp a call. They have a silver plating compound I have used for the past couple of years that solves all of the above problems and more. This white powder has an infinite shelf life...and is easy to use.

"It will actually put a permanent silver plate on copper, brass or bronze...There are no messy or dangerous chemicals. Application could not be easier. Use a clean rag and a little bit of water and just rub it on a clean surface. In minutes you can permanently silver plate a circuit board or replating a power amp tube or socket.

"It has saved me time, money and my sanity."

Cool amp has even outperformed electroplating in recent tests. It is time-proven since 1944.

COOL-AMP

AND CONDUCTO-LUBE. THE SILVER-BASED CONDUCTIVE LUBRICANT.

The upstart, since 1952. Developed for switches, uses continue to expand to all applications needing a conductive lubricant.

Conducto-Lube

ORDER FACTORY DIRECT:

503-624-6426 or FAX 503-624-6436

<http://www.thomasregister.com/cool-amp>

BREAKTHROUGH IN SURFACE MOUNT REWORK

We have put together a very inexpensive package for reworking fine pitch surface mount components with a minimum amount of expertise and technical ability. If you can use a soldering iron effectively, then you can remove and replace most surface mount components fast, effectively and at a very low temperature. You will soon make them look like they have never been replaced. Read on to find out more about this exciting new product.



With the **EDSYN** soldering iron pictured, or any **EDSYN** Soldering Iron, and a special **EDSYN** soldering tip called the **Mini-Wave Soldasip®**, and the **SMD-1** rework kit from **CHIPQUIK**, most SMD's can be replaced very effectively and inexpensively. **CHIPQUIK** solder (which melts at 136° F), is applied to the solder points of the device. The 136° melting point of the low temperature solder is mixed with the solder on the chip, to bring the melting point of the mixture much lower than normal, allowing the SMD to be removed with a set of tweezers. Clean-up is then accomplished with the accessories in the kit. After clean-up the IC is aligned and tacked down with regular solder on opposing corners.

The new **Mini-Wave Soldasip®** tip from **EDSYN** is a cylindrical tip cut at a 45° angle on the end. The tip end is cupped, or concave, so it will hold solder in the cup. Flux is then applied to the leads of the IC and regular wire solder applied to the cup of the mini-wave tip. Holding the iron at a 45° angle, drag the solder tip parallel to the

body of the IC or perpendicular to the leads. The solder in the cup of the tip is then applied to leads of the IC making a permanent bond between the leads and the pads of the PC Board. If bridging occurs, it is usually because of too much solder in the cup. Clean the tip with the sponge and wipe the bridge away from the IC with the tip. If the bridge does not clear, simply apply more flux and repeat the wipe and it will clear.

In my years of experience, I have never seen a more effective way of replacing a surface mount. It also happens to be the most inexpensive. Check out our package price and you will see why I am so excited about this. For more information on this package go to <http://www.heinc.com/951sxtpt.html>.



- 1 - **EDSYN 951SX** Temperature Controlled Solder Station
- 1 - **Mini-Wave Soldasip®** Tip
- 1 - **SMD-1** Chip Quik Removal Kit

\$135.00
Order Now

For more info on Soldering & Desoldering go to <http://www.heinc.com>

For more information on this package please go to <http://www.heinc.com/951sxtpt.html>

Visa - M/C - Discover - American Express - Terms to Qualifying Companies
30 Day Money Back Total Satisfaction Guarantee - 18 Month Parts and Labor Warranty

Howard Electronic Instruments, Inc. 6222 N. Oliver Kechi, KS 67067

HOWARD
HEI ELECTRONIC
INSTRUMENTS
Your Desoldering Specialists **INC**

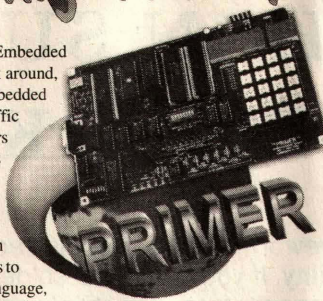
Toll Free U.S. and Canada

1-800-394-1984

Web Site www.heinc.com
E-Mail sales@heinc.com
International (316) 744-1993
or Fax (316) 744-1994

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. **So don't be left behind; this is information you need to know!**



Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1998
OVER
12
YEARS
OF SERVICE

PIC'n Books

LEARN ABOUT PIC16/17 MICROCONTROLLERS

EASY PIC'n Beginner

- Programming techniques
- Instruction set
- Addressing modes
- Bit manipulation
- Subroutines
- Sequencing
- Lookup tables
- Interrupts
- Using a text editor - source code
- Using an assembler
- Timing and counting
- Interfacing - I/O conversion
- Lots of examples

\$29.95

PIC'n Up The Pace Intermediate

- Serial communication
- PIC16 to peripheral chips
- PIC16 to PIC16
- Serial EEPROMS
- LCD interface
- Scanning keypads
- D/A conversion
- Sensors - analog voltage output
- A/D conversion
- Math routines
- Decimal interface
- PIC16F84 EEPROM data memory
- Lots of circuits and code

\$34.95

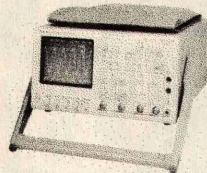
+ \$4 s/h in US for one book, \$5 both books

VISA, MC, AMEX, MO, Check

CA residents please add 7.25% CA sales tax
PIC is a trademark of Microchip Technology Inc.

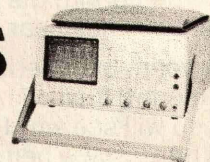
SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
Web Site: <http://www.sq-1.com>
E-Mail sqone@picfic.net



Test Equipment Sales

Check out our New Year's specials!



HP 8590A SPECTRUM ANALYZER.....\$4295
HP 3325A-002 SIG.GENERATOR.....\$1495
HP 11692D DIRECTIONAL COUPLER.....\$395
HP 3585A SPECTRUM ANALYZER.....\$5995
TEK SG503 LEVELED SINE GENERATOR...\$525
TEK 2246 100 MHz 4CH. SCOPE.....\$1295
TEK 465 100MHz 2 CH. SCOPE.....\$400
TEK PS5010 TRIPLE OUTPUT P.S. P/I.....\$695
ROD-L M100AVS4 HIPOT TESTER.....\$475
BMI G-111 CARD FOR 4800.....\$195
FLUKE 752A REFERENCE DIVIDER.....\$1895

FLUKE 5440B DC VOLTAGE STD.....\$1795
AR 4040AT HIPOT TESTER.....\$650
HP 1651A LOGIC ANALYZER.....\$1295
HP 3488A SWITCH CONTROL UNIT...\$795
GR 1657 RLC BRIDGE.....\$695
HP 16515A 1 GHz TIMING CARD.....\$1195
AR 5060AT HIPOT TESTER.....\$650
HP 3478A DIGITAL MULTIMETER.....\$650
FLUKE 343A DC VOLTAGE STD.....\$750
WAYNE-KERR 4250 LCR METER.....\$1295
WAV 801 50 MHz PULSE GEN.....\$575



Ask about our line of new products including
HP, LeCroy, Instek, Tektronix, Fluke and more!



CALL 800 684-4651 OR FAX (603) 425-2945

CHECK US OUT AT WWW.TESALES.COM

Digital Power Meter



Measures
Watts
& Watt-hours
(kW-hr)

Simple to use.
Plug the Power Meter
into any AC outlet, and plug the
appliance to be measured into the
Power Meter. That's it!

Model 4-1850:

- Measure REAL ("true") power
1 to 1850 Watts
- Measure Power used, 1 Watt-hour
to 9999 kilo-Watt-hr
- Measure power cost (\$), just enter
cost per kilo-Watt-hr

New! Advanced model
with additional features
Irms, Vrms, Power Factor,
20 mhz processor and more!
Model 20-1850

Performs the same functions as instruments costing \$500-\$1000!
No other instrument on the market even comes close for this price!!

Model 4-1850 Only \$149.⁹⁵ Delivered!
Model 20-1850 Only \$249.⁹⁵ MC/Visa/MO/Check

Custom applications available • Dealer inquiries welcome

Brand Electronics,
421 Hilton Rd.
Whitefield, ME 04353

For information only, call 1-207-549-3401

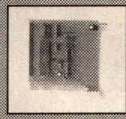
Call today! To order, call toll free, 24 Hrs.

1-888-433-6600

<http://www.mint.net/~ebrand/>

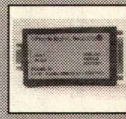
CONTROL RELAYS • LIGHTS • MOTORS MEASURE TEMPERATURE • PRESSURE • LIGHT LEVELS • HUMIDITY INPUT SWITCH POSITIONS • THERMOSTATS • LIQUID LEVELS

MODEL 30 \$79



- PLUGS INTO PC BUS
- 24 LINES DIGITAL I/O
- 8 CHANNEL
- 8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SAMP/SEC

MODEL 45 \$189



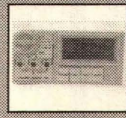
- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT

MODEL 100 \$279



- 12 BIT 100 KHZ A/D
- 4 ANALOG OUTPUTS
- 3 TIMER COUNTERS
- 24 DIGITAL I/O

MODEL 150-02 \$179



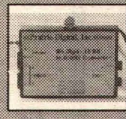
- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- COMPLETE DMM

MODEL 40 \$109



- RS-232 INTERFACE
- 25 LINES DIGITAL I/O
- 8 ANALOG INPUTS
- PWM OUTPUT

MODEL 70 \$239



- RS-232 INTERFACE
- 16 BIT A/D
- 5.5 DIGIT
- UP TO 60 SAMP/SEC

Prairie Digital, Inc.

PHONE 608-643-8599 • FAX 608-643-6754

920 SEVENTEENTH STREET • PRAIRIE DU SAC, WISCONSIN 53576

CIRCLE 315 ON FREE INFORMATION CARD

0% FINANCING for 2 Months

2 payments \$29 Books
2 payments \$29 Books
back issue, perfect for
Service & Experimenter
IC MASTER
97 ICM CD
2 Easy Payments of
\$75!!
\$235
2 Easy Payments Any Product

Complete
Catalogs of ALL Major
Component Manufacturers

2 payments \$29 97 EEM CD
or books

2 payments \$44 98 EEM CD

2 payments \$59 96 ICM CD
96 for Lite Design & Service

2 payments \$52 96 ICM Books

2 payments \$75 97 ICM CD
97 for Moderate design

2 payments \$65 97 ICM Bks

2 payments \$99 98 ICM CD
98 for advanced design

2 payments \$93 98 ICM Bks

Service Center Favorite

SEMICONDUCTOR

CROSS

REFERENCE

& SPEC

Quarter Million

Transistors, ICs & Diodes

with REFERENCE

A Specialist in "Hard to Cross House Numbers"

Easy, Powerful & Fast. The Most Comprehensive

Software Sold. A selection yields Device Specifications

& 75 to 250 Potential Replacements!

Replacement Numbers are Totally Global including Domestic, Asian, European, House

Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead

Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers

is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, Win3.1 & 95

Latest Version 7.11 Includes Many Helpful Conversion Utilities, Tables & Formulas.

Includes: 4 HUGE Consumer Electronics Industry Directories

1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers

3- The Entire Computer Industry 4- Semiconductor Manufacturers

Perfect for Service, Engineering and Purchasing.

Shop the way the Pro's do, Use Their Tools!

These are the books that find the "Gold". For many years they've been used by the Sharpest Purchasing Agents. Look under every rock... they're impossible to find at ANY price, let alone a great deal like this. Find: Distributors, Manufacturers and Service providers for Products, Services or ANY Component Parts imaginable from USA & Canada. Sources for Everything from Gears to Semiconductors to Foreign Assembly Services.

all 6 pieces!

WOW 2 payments \$239!
Instant credit!

Great Gift
2 payments \$239 NEC 486 DX4-75
12m-340m-9.5" active-W95-PC/MIA

Real Beauties!
2 payments \$282 Compaq 486 DX4-100
16m-710m-10.4"ds-W95-PC/MIA
may differ from illustration

Parts Source Library
Best Kept Secrets

Only a few left
2 payments \$282 Compaq 486 DX4-100
16m-710m-10.4"ds-W95-PC/MIA
may differ from illustration

10-9 EST
7 Days

All Cards & COD we don't sell parts Sorry, NO catalog

Netcom 800-733-3733 ext 6300 FAX 516-826-7776

CIRCLE 219 ON FREE INFORMATION CARD

Mark V Electronics, Inc.
8019 E Slauson Ave
Montebello CA 90640

Free Catalog 323/888-8988
Fax 323/888-6868

**DIY Audio Electronic Kits
Enclosures & Transformers
more than 60 items available!**

http://www.mark5co.com Email: mark5co@aol.com
ORDER 1-800-521-MARK / 1-800-423-FIVE

3 1/2 Digital LED Panel Meter #TY-43

It is a precision A/D converter integrated circuit. The display is a 6" LED for high visibility. It is easy to assemble and use the meter as a voltmeter, ammeter, ohmmeter, thermometer, frequency counter or capacitance meter. DC±199.9mV full scale input 5-6VDC.

Kit: \$28.00 **15.00**

Fluorescent Light Driver #TY-2

This unit drives 6-40 watts fluorescent light for portable & emergency use. Works from a 7.2-16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

9.99
Kit: \$78.75

300W MOSFET Power Mono Amp #AF-3

300W RMS into 4 ohms, 200W RMS into 8 ohms. Frequency response: 10Hz-20KHz. THD < 0.03%. S/N 91 dB. Input Sensitivity & Load impedance at 1KHz, 1V 47K & 4-16 ohm. Power Requirement: ±55V - ±65V DC at 8A (each channel). A speaker protection circuit which provides time delayed speaker turn on.

132.00
Kit: \$165.00

We accept Visa, MasterCard, Discover & Money Orders. Checks allow 2 weeks for clearance. We ship by UPS ground inside US (min \$5.00) and ship by US mail outside US. Please call for orders shipping & handling or fax (foreign) orders. In business since 1985.

20 Color LED Audio Level Meter #TY-13

Use this dual LED display indicating meter with your stereo power amplifier to indicate instantaneous speaker power. Operating range is -30dB to +5dB & can be calibrated to operate with 1-200W amplifiers. Not consume any amplifier power. A peak LED illuminates on overload!

Kit: \$23.50 **9.99**

40W Mini Stereo Multi-Input Amp #TA-83

Operated from AC source as well as 12V DC car battery. Used as a microphone PA amplifier while simultaneously mixing with an auxiliary input source such as CD & MD player.

Kit: \$30.50 **24.40**

120W + 120W Pre & Main Stereo Amp

It has provision for input program source switching, a phono pre-amp stage with RIAA equalization, 3-band tone controls, built-in power supply rectifier & filter & a speaker protection circuit. It only needs to be installed in a suitable housing & the addition of a power transformer in order to make it operational. #TA-800MK2

57.73
Kit: \$67.99
Asmb.: \$86.95

Project Kits Source...

#TA-120 36W Class A Power Mono Amp \$ 32.50
#TA-388 FET Class A Stereo Pre-Amp 64.00
#TY-25 Stereo Loudspeaker Protector 16.75
#KA-905 75-in-one Lab Kit 24.99

**Metal Cabinets
Aluminium Front Panel**

Best Buy

LG-1273 3x12x6 1/4" \$ 26.50
LG-1684 4x16x8" 32.50
LG-1924 4x19x11 1/2" 38.25
LG-1925 5x19x11 1/2" 42.00
LG-1983 2 1/2x19x8" 35.25
LG-1923 3x19x11 1/2" 36.50
LG-1927 7x19x11 1/2" 50.50
LG- Black anodized rack cabinet

LL-1923B 2 1/4x19x12" \$ 69.50
LL-1925A 5x19x12" 79.50

*LL-Full Aluminum Front .157" & other .078"
*LL-Gold plated cap screw for front panel

**Power Transformer
Toroidal Transformers**

#001 28/30Vx2 6A \$ 30.00
#002 36Vx2 3A 25.00
#003 40Vx2 6A 32.00
#004 24Vx2 6A 25.00
#005 26Vx2 3A 19.00
#006 18Vx2 5A 19.00
#007 53Vx2 8A 47.00
#008* 28/30Vx2 6A 40.00
#009* 48/53Vx2 8A 66.00
#010 30/36Vx2 400mA 8.50
#011* 9Vx2 22A 62.00
#012* 33/42Vx2 6A 48.00



Transformer



*Toroidal Transformer

150 Mhz 8 Digit Frequency Counter

#SM-100



Kit \$79.00 **68.00**
Asmb \$99.00

It is used for adjustment, test & repair of any kind of high frequency circuit products. It can give up to 8 digit of resolution for a wide frequency range 10Hz - 150 MHz. The last input frequency can HOLD on the display for future reference & comparison. The circuit structure is compact & reliable for the most updated A/D LSI circuitry. The input impedance is 1M ohm.

CIRCLE 325 ON FREE INFORMATION CARD

BEST DEALER PRICING!

CABLE DIRECT
CONVERTERS • FILTERS
DESCRAMBLERS

IMPROVE YOUR IMAGE WITH
VIDEO STABILIZERS

**FREE
CABLE TV
CATALOG!**

**100%
MONEY BACK
GUARANTEE!**

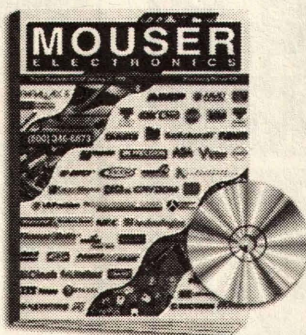
Now you can tune-in your favorite cable TV programming and **SAVE \$100'S - EVEN \$1000'S** on premium CABLE TV EQUIPMENT.



**MODERN
ELECTRONICS**
1-800-906-6664

2609 S. 156TH CIRCLE • OMAHA, NE 68130
http://www.modernelectronics.com

ELECTRONIC COMPONENTS



Visit our web site!
www.mouser.com

Catalog is available on the internet, CD-ROM, or in paper!

- Over 72,500 Products
- More than 145 Suppliers
- Same Day Shipping
- No Minimum Order

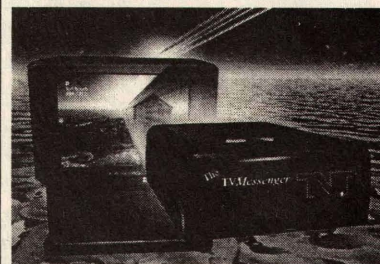
800-992-9943

817-483-6828 Fax: 817-483-6899
catalog@mouser.com

958 North Main St., Mansfield, TX 76063

CIRCLE 318 ON FREE INFORMATION CARD

TVMessenger
Caller ID for TV!



TVMessenger provides:

- Convenience
- Uninterrupted TV viewing
- Callers' log
- Visual call indicator

• Ease of use
• Security
**Not available
In stores!**

**only
\$89.95**

Arrow Technologies

13341 A St., Omaha, NE 68144

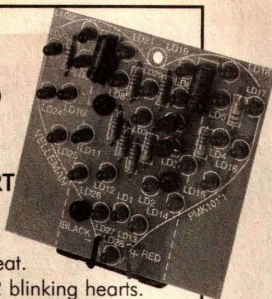
1-888-554-2776

47pc•kit

\$12.95

**MK101
SWEETHEART**

Give him or her that special heartbeat. 28 leds form 2 blinking hearts. Power supply : 9V battery

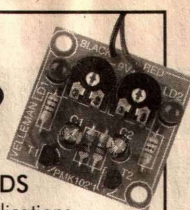


14pc•kit

\$5.95

**MK102
FLASHING LEDS**

For different applications (such as model construction) and educational purposes. Adjustable flashing speed. Power supply : 9V battery

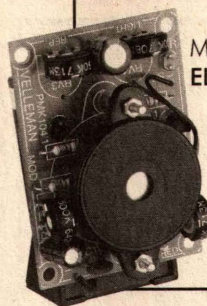


30pc•kit

\$14.95

**MK104
ELECTRONIC CRICKET**

This cricket turns on when it gets dark. Great as practical joke. The tone and repetition between two crickets is adjustable. Power supply : 9V battery

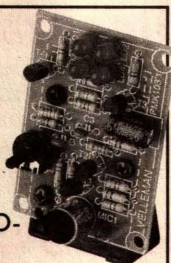


34pc•kit

\$9.95

**MK103
LED SOUND-TO-
LIGHT UNIT**

For different funny and practical applications. 4 high-intensity leds light up and react simultaneously on every sound. Power supply : 9V battery

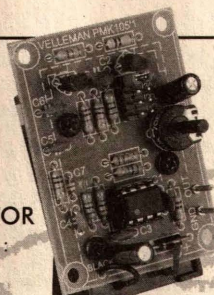


36pc•kit

\$10.95

**MK105
SIGNAL GENERATOR**

Several signal outputs : square wave, triangle, sine and integrator which are selectable with a jumper. The signal frequency is about 1KHz (fixed) Ideal to learn electronics! Power supply : 9V battery

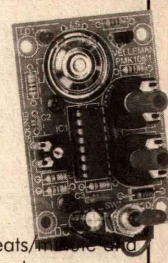


26pc•kit

\$14.95

**MK106
METRONOME**

The beats per minute are given by a built-in speaker and by a led. Adjustable volume, beats per minute and sound. With on/off switch. Power supply : 9V battery

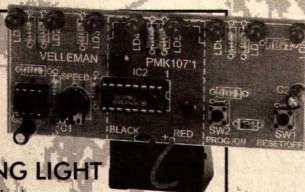


36pc•kit

\$12.95

**MK107
LED RUNNING LIGHT**

8 leds running light. Different running effects are selectable (by prog push button). Adjustable effect speed. Power supply stand-by by push button. Power supply : 9V battery

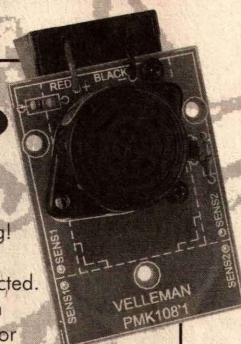


8pc•kit

\$7.95

**MK108
WATER ALARM**

Never let you surprise by flooding! Gives alarm sound when water is detected. Incorporated alarm buzzer. Water sensor can be placed at distance by cutting the board and using wires to connect the sensor. Power supply : 9V battery

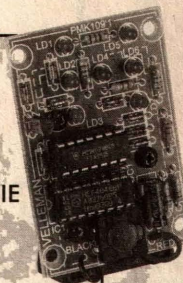


35pc•kit

\$9.95

**MK109
ELECTRONIC DIE**

No more cheating allowed ! The eyes of the die are leds. Rolls out when the push button is released. Power supply : 9V battery

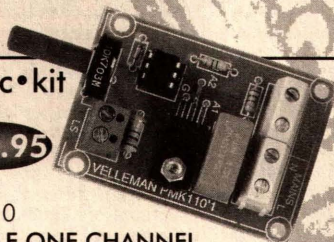


17pc•kit

\$12.95

**MK110
SIMPLE ONE CHANNEL
LIGHT ORGAN**

With loudspeaker input. The lamp flashes on the beat of the music. Optical isolated loudspeaker input with adjustable sensitivity : 2W to 60W. Maximum load : 120W at 120Vac.

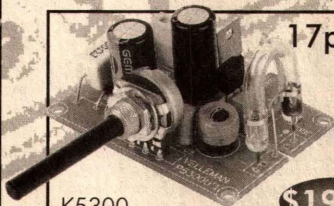


17pc•kit

\$19.95

**K5300
STROBOSCOPE**

Adjustable flash frequency : 5-15Hz. Power supply : 120Vac. Power consumption : 13W max.

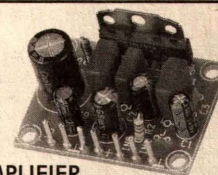


21pc•kit

\$12.49

**K2637
SUPERMINI 2.5W
AUDIO POWER AMPLIFIER**

Superb audio amplifier with incredible tiny dimensions. Integrated circuit has a pre- and power amplifier which can be used separately. Max. output power : 2.5W @ 4ohm. Frequency characteristics : 60Hz to 15KHz. Power supply : 4.5V to 15Vdc / 400mA



Exists also as module : M2637 **\$17.49**

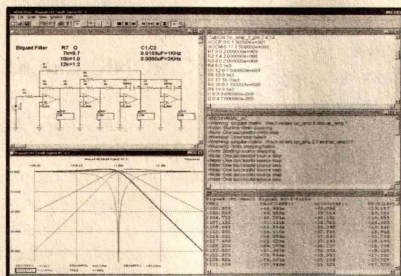
velleman

7415 Whitehall Street Suite 119
Fort Worth, TX 76118
(817) 284-7785 F : (817) 284-7712
www.velleman.be email : velleman@earthlink.net

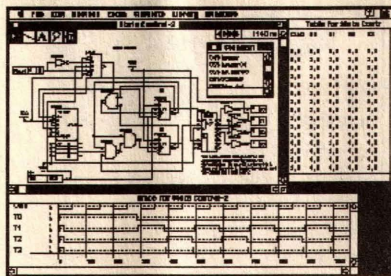
Questions ? Contact us for a list of US distributors or to get your **FREE** catalogue

CIRCLE 282 ON FREE INFORMATION CARD

CIRCUIT DESIGN FOR WINDOWS AND MACINTOSH



B² SPICE



B² LOGIC

B² SPICE and B² LOGIC are the best values in circuit simulation tools. They are used at over 100 major universities and many leading Fortune 500 companies including the University of Michigan, Stanford, AT&T, General Electric, and Motorola.

B² Logic provides precise and customizable timing of individual pins on each device. No other program in this price range will help you catch as many timing glitches and violations. It also supports busses and subcircuits to facilitate the design of complex circuits.

B² Spice integrates an intuitive interface with an optimized Spice engine. With a library of over 3000 parts, you will be able to find the part you need. In case you don't find it, you can easily import new parts into the libraries. The interface supports the full set of Spice3F5 simulations as well as Temperature and Parameter sweeps.



Beige Bag Software
279 E. Liberty
Ann Arbor • Michigan • 48104

Phone 734.332.0487
Fax 734.332.0392
E-Mail info@beigebag.com
Internet www.beigebag.com

B² SPICE \$249

- Simulations: DC, Parameter, Dual, and Frequency Sweeps, Transient, Noise, Fourier, Transfer Functions, Pole-Zero, Distortion
- Spice 3F5 (32-bit)
- Over 3000 devices
- Over 30 parameterized devices
- Powerful graph interface
- Device and model parameter dialogs
- Run simulations directly from netlists

B² LOGIC \$179

- Subcircuits and subcircuit probing
- Precise customizable pin timing
- Over 100 components available
- Define new devices with equations and tables including state variables

ELECTRONIC DESIGN PACKAGE \$279

- Includes B² SPICE and B² LOGIC

- Demo Disks Available
- University & Student Prices Available
- Site Licenses Available
- Dealer Inquiries Welcome
- Visa/MasterCard Accepted

CIRCLE 304 ON FREE INFORMATION CARD

HACKING THE INTERNET

The latest tricks and methods being used on the Net to pirate software (warez) and the newest hacking websites. Includes examples, countermeasures, password defeats, UNIX, Sprintnet, brute force techs, lots of tips. *More!* \$29.

INTERNET TRACKING & TRACING: Scammers, spammers, stalkers, infectors, and others hide behind the Internet's anonymity to commit serious offenses. Learn from master hackers best methods to track & trace IDs and origins, and to protect your own privacy. *More!* \$29.

INTERNET CONS & SCAMS: Internet cons, scams and related frauds now rake in \$2+ Billion annually! Most are done anonymously with impunity. Details how they're done, how to ID them, how to protect yourself. *More!* \$25.

THE COOKIE TERMINATOR: When online, many websites track your every move! Browser cookie, history and cache files contain personal data readily accessible to Internet predators, scammers, spammers and snoops. Your financial, medical, political, habits, lifestyle, future plans data is exposed to the world! Step-by-step how to remove and stop cookies from destroying your privacy. \$25.

PBX HACKING
PBXs hacking losses are at \$5-\$10 Billion annually! Details how PBXs are hacked, countermeasures. Author interview in *Forbes!* \$24.



CONSUMERTRONICS
2430 Juan Tabo, NE, #259, ABQ, NM 87112
P.O. Box 23097 ABQ, NM 87192
Fax: 505-292-4078 (all hours, orders only) Voice: 505-237-2073 (10-6 M-F)

Full Catalog: www.tsc-global.com/consumer.html Adventure: www.tsc-global.com
Established in 1971. Featured on CBS "60 Minutes," *Forbes*, *New York Times*. Add \$5 total S/H (US Canada). Postal MO is fastest! VISA, MC OK. No CODs. Take 10% OFF all Orders over \$100 and Take \$2.00 OFF all New Orders over \$20 placed by Mail or Fax. Catalog \$1 w/order, \$3 w/o.

Sold for legal educational purposes only. See Catalog for LIMITED WARRANTY, SPECIAL PROJECTS and all other applicable policies.

CELLPHONE MODIF. GUIDE

How cellphones operate and are modified. Vulnerabilities to hack attack and countermeasures. Cloning details for NAMS, ESNs, etc. control data formats, computing encoded MINs, ESNs, SIDHs, Op Sys, PROMs, forcing ACK, test mode and resets, cable diagrams, scanning, tracking, scanner restorations, freq allocations, roaming, step-by-step to keypad-reprogram 100+ popular cellphones. One FREE database search. *More!* \$49.

PAGER (BEEPER) MANUAL: How Pagers work, different types and uses, freqs, advantages over and uses with cellphones, and tips and tricks. How Pagers are hacked/countermeasures. And plans for a **Personal Pocket Paging System** (xmitter and receiver). *More!* \$29.

Both for only \$69!

PHREAKING CALLER ID & ANI

How they work and dozens of ways of defeating Caller ID, ANI, *69, *57, Call Blocking, *67 etc. Describes ESS, SS7, CN/A, CAMA, DNR, Diverters, Centrex—more! \$25.

HACKING FAX MACHINES

Details all known methods of hacking faxes and countermeasures. Includes computer fax modems, crimes, interceptions, fax servers, fax-on-demand, protocols, parameters, compression, encryption, and fax surveillance-type mods. *More!* \$29.

VOICE MAIL HACKING

VMS are hacked to penetrate PBXs to make outgoing calls, get free VMB usage, secretly read/change/delete messages, or damage the VMS (or its PBX) itself. Step-by-step on how it's done, countermeasures. \$29.

STOPPING POWER METERS

As reported on "60 MINUTES"! New 6th Edition! Plans for devices that can slow down (even stop) watt-hour meters - while loads draw full power! Devices plug into one outlet and normal loads into other outlets. Describes meter creep, overload droop, pole meters, etc. \$29.

SPM THE VIDEO: Now it's easier to learn about KW-HR Power Meters than ever before! This educational video shows you how they work and their anatomy. Demonstrates SPMEM device and external magnetic methods used to slow and stop meters! Hosted by a top expert in the field. From the novice to the pro, an excellent source of info on these exciting devices! Great in combo with our SPM related manuals! \$29.

THE I.G. MANUAL: External magnetic ways (applied to meter) to slow down and stop power meters while drawing full loads. Plans \$25.

KW-HR METERS: How watt-hour meters work, calibration, error modes (many), ANSI Standards, etc. Demand and Polyphase Meters. Experimental results to slow and stop meters by others. \$25.

Any 2 for \$49, 3 for \$64, all 4 for \$79!

COMPUTER PHREAKING

Describes in detail how computers penetrate each other, and how VIRUSES, TROJAN HORSES, WORMS are implemented. Dozens of computer crime and abuse methods and countermeasures. Includes disk filled with hacker text files and utilities, and the legendary FLUSHOT+ protection system. Internet advice, password defeats, glossary - much more! Manual + PC Disk! \$39.

THE HACKER FILES: 3 HD PC disks filled with choice raw, colorful and highly informative hacker, phreaker text files covering many topics! \$39.

Both for only \$69!

BEYOND VAN ECK PHREAKING

Plans for remote eavesdropping of TV video signals. Range up to 1 KM. Describes how van Eck systems work, and are also used in surveillance of computer systems. \$29. The van Eck Demo Tape is \$29. Both for only \$49!

MANY MORE TITLES!

Beyond Phone Color Boxes • \$29
Hacking Answer. Machines • \$19
Casino Hacking • \$25
Automatic Teller Machines • \$39
Credit Card Scams • \$29
Cons & Scams • \$29
Social Engineering • \$29
Polygraph Defeats • \$25
By an Order of the Magnitude • \$49
Ultimate Success Manual • \$19
Stealth Technology • \$19
Secret & Survival Radio • \$19
High Voltage Devices • \$29
Mind Control • \$29
Under Attack! • \$29
Radionics Manual • \$29
Heal Thyself • \$19
Secrets of Solderless BBs • \$24
Secret & Alternate IDs • \$15
Cryptanalysis Techniques • \$29
Government Land Grab • \$15
Rocket's Red Glare • \$29
Survival Guns & Ammo • \$19
The Ultimate Driver • \$19

THE DIRTY-2 DOZEN!

24+ Hot Hack/Phreak Disks!

See CATALOG!

SPECIAL PROJECTS

We will design & build just about anything electronic! Hardware done as SPECIAL PROJECTS only. See Catalog for details and SP Application Form, else: www.tsc-global.com/spaf-spp.html

CIRCLE 226 ON FREE INFORMATION CARD

**OVER
30,000
ITEMS
IN STOCK**

**LARGE VARIETY
SAME DAY SHIPPING**
Minimum Orders \$20.00

Not Including Shipping & Handling

Dalbani®
The Ultimate Saving Source

SEMICONDUCTORS

Original #	Brand	Replaces
7805	Tesla	960
7806	Ank	962
7809	Ank	1910
7810	Samsung	1968
7812	Tesla	966
7815	Tesla	968
7818	Tesla	958
7824	Tesla	972
7905	Tesla	961
7906	Tesla	963
7908	Tesla	965
7912	Ank	967
7918	Tesla	959
7924	Tesla	971

YOUR CHOICE

45¢
each

POPULAR FUSE KIT 180 Piece Kit

Kit Contains 10 Pieces of each of these items:

- AGC Type : 0.5A, 1A, 1.5A, 2A, 2.5A, 3A, 4A, 5A, 6A, 10A, 15A
 - Ceramic Type : 15A
 - GMA Type : 1A, 1.5A, 2A, 3A, 4A, 5A
- Everything Comes in a Durable Plastic Box

Item # 10-2050

\$13.95

TUN-O-WASH® (CFC Free)

Fast drying electronics grade cleaner for tuners, controls and PC boards.

- CFC and HCFC free
- Not for use on energized equipment

* Due to the chemical content, this product can be only shipped by UPS ground service.

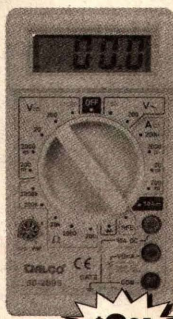
Item # 30-0100
(12.5 Oz aerosol)

\$11.75

DALCO DIGITAL MULTIMETER

- DC Voltage: 200m-1K
- AC Voltage: 200-750V
- DC Current: 20m-20
- Transistor and Diode Test
- Continuity Buzzer
- Polarity indicator appears on LCD
- Test Probes Included
- Dimensions: 4.96" x 2.76" x 9.4"
- Weight: 6 oz.
- 9V Battery Included

Item # 50-2895



\$9.95

Dalco®

ECONOMICAL SOLDER WICK

- Length: 5 feet
- Width: 0.15"
- Safer Desoldering
- Fast Response

Item # 51-1050

5 Feet



\$1.10

SOLDER ROLL

- 1 LB Spool
- 370° F melting point
- Fastest solder
- Alloy 60/40, tin lead, non corrosive flux, Diam. 1.0mm

Item # 51-1005

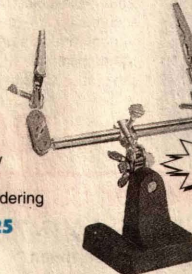


\$5.49

DUAL HELPING HANDS

- Hold Work in any Position to leave hands free for soldering

Item # 50-1325



\$3.45

SOLDERING IRON

- General Purpose Applications
- 117V AC, 30 Watts

Item # 51-1335



\$3.25

Weller WLC100 SOLDERING STATION

Weller®



\$38.90

- Ideal for the professional, serious hobbyist
- Variable power control (5-40W)
- 40W pencil iron and ST# inter changeable tip
- Replaceable heating element
- Cushioned foam grip • Safety guard iron holder
- On/off switch with "power-on" indicator light

Item # 51-1505

SHIP UP TO **5lbs** FOR ONLY

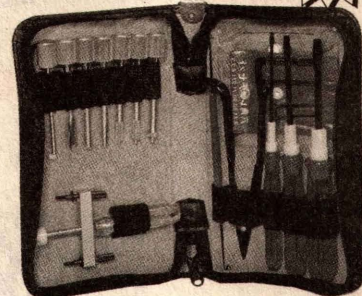
\$3.95



Plus handling & C.O.D. charge if it applies

THE MOST POPULAR VCR ALIGNMENT TOOL KIT

\$24.99



- VCR Head pull
- Retaining ringremover
- Micro screwdriver
- Fitted vinyl Case
- 7 Assorted head & guide aligner
- Dimensions: 9 1/2" (W) X 12 1/4" (L)
- 3 Reverseable screwdrivers (Small-Flat-Phillips)
- Spring hook
- Hex key set
- Soft zippered case

Item # 50-888

HEAVY DUTY COLOR CODED LEADS

- 10 Leads
- 11" Long Wire Lead
- Insulated 11/2" Alligator Clips
- 20 Gauge Wire Size
- Black, Green, Red, Yellow, White

Item # 56-500



\$2.95

Dalco® SWING ARM MAGNIFYING LAMP

\$36.72



White Color

- Spring-Balanced 45" extension arm with 3 conductor cord 120V 60Hz
- Steel Shade supplied with a precise 3 diopterlens and a 22W fluorescent circline tube
- Comes with a lamp

Item # 54-0120

Dalbani®

4225 NW 72ND AVE. MIAMI, FLORIDA 33166
TEL : (305) 716-1016 ----- FAX : (305) 594-6588

**Free 400 Page Color Catalog
With your First Order**

1-800-325-2264

CALL TOLL FREE
(800) 292-7711 orders only
Se Habla Español

C&S SALES

EXCELLENCE IN SERVICE

LOOK FOR OTHER
MONTHLY SPECIALS
ON OUR WEBSITE

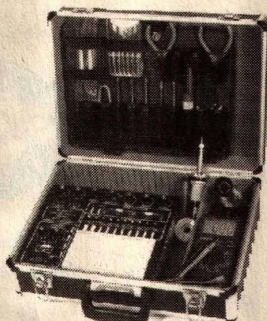
XK-700 Digital / Analog Trainer

Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square waveforms and a 1560 tie point breadboard area. Tools and meter shown optional. (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled and Tested
\$189.⁹⁵

XK-700 - SEMI KIT
w/ Fully Assembled PC Board
\$174.⁹⁵

XK-700K - Kit
\$159.⁹⁵



Made in the USA

Digital Multimeter Model M-1740

\$39.⁹⁵
Free Holster

- 11 functions
- Freq to 20MHz
- Cap to 20μF
- AC/DC Voltage
- AC/DC Current
- Beeper
- Diode Test
- Transistor Test
- Meets UL-1244 safety specs



DIGITAL LCR METER Model LCR-1810

\$99.⁹⁵



- Capacitance .1pF to 20MF
- Inductance 1μH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display

15pc. VCR Service Tool Kit Model TK-1400

- Inclined Base Screwdriver
- Eccentric Screwdriver
- 2mm & 3mm Fine Adjust Screwdriver
- VHS VCR Head Puller
- Retaining Ring Remover
- 3 Reversible Screwdrivers
- Spring Hook Tool
- Micro Screwdriver
- Hex Wrench Set

Special
\$24.⁹⁵



Model M-6100

The M-6100 is Elenco's most sophisticated meter with almost every possible feature available. The M-6100 even has a computer interface for viewing and storing data on a personal computer. It comes complete with software, RS-232 cable, test leads and manual.

\$99.⁹⁵

Model XP-581

4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A

\$89.⁹⁵



Tektronix DMMs

For high performance digital multimeters that are accurate, reliable, and rugged, the DMM900 series extends the Tektronix line of already affordable DMMs. Twice the accuracy. Up to 10 times the resolution. And a full range of capabilities that span voltage, current, dual numeric display, 3 year warranty, and autorange capability. All backed by the reliability of the Tektronix brand.



912 \$179
914 \$229
916 \$275

Power Supply Kit Model XP-720K

3 fully reg. DC supplies
1.5VDC - 15VDC @ 1A
-1.5VDC to -15VDC
5VDC @ 3A

Plus
6.3VAC @ 1A and
12.6VAC C.T. @ 1A

\$54.⁹⁵

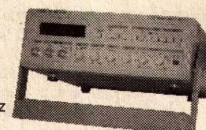


Available assembled Model XP-720 \$84.95

Sweep Function Generator with built-in Frequency counter Model GF-8026

\$225

- Range .02Hz - 2MHz
- Sine, Square, Triangle, Pulse, Ramp
- Ext. counter 1Hz - 10MHz



Kit Corner over 100 kits available

AK-700

\$15.⁹⁵

Phone kit with training course
4 Flashing neon lights
See thru case



RADIO CONTROL CAR KIT MODEL AK-870

- 7 functions
- Remote control included

\$24.⁹⁵

No Soldering Required



Model AM/FM-108K Transistor Radio Kit with training course

\$29.⁹⁵



35mm Camera Kit Learn all about photography AK-540

\$14.⁹⁵



No Soldering Required

Digital Capacitance Meter Model CM-1555

\$48.⁹⁵



- Capacitors from .1pF to 20M μF
- 3 1/2 Digit LCD
- Zero adjust
- special insertion jack
- 1/2% basic accuracy
- Tilt stand

Digital Audio Generator with built-in Counter SG-9300

- 10Hz - 1MHz
- Low Distortion
- Sine/Square waves
- Built-in 150MHz Frequency Counter

\$175



SG-9200 Analog/No counter \$119.95



SATELLITE FINDER Model SF-01

- Aligns Satellite Dishes
- Range 950-2050MHz
- Compact Size
- Self Power Check



\$39.⁹⁵

RF Generator with Counter Model SG-9500

\$225

- 100KHz - 150MHz
- Internal AM Mod of 1KHz
- RF Output 100MV - 35 MHz
- Audio Output 1KHz @ 1V rms



SG-9000 Analog/No counter \$119.95

WE WILL NOT BE UNDERSOLD C&S SALES, INC.

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



15 DAY MONEY BACK
GUARANTEE
FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 322 ON FREE INFORMATION CARD

**Same Day
Shipping**

C & S SALES
Your one stop source for
all your electronic needs!

CALL OR WRITE FOR OUR
**NEW FREE 64 PAGE
CATALOG!**
(800) 445-3201

Fluke Scopemeters



123.....NEW.....\$1140
92B.....\$1445
96B.....\$1695
97.....\$1695
99B.....NEW.....\$2095
105B.....\$2495

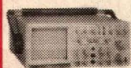
**ALL FLUKE
PRODUCTS
ON SALE**

B & K PRECISION SCOPES

20MHz DUAL-TRACE
Model 2120B - 2 Year Warranty

Special \$375

Model 2125A with delayed sweep
\$539.95



- 1mV/division sensitivity
- AUTO/NORM triggered sweep operation
- AC, TVH, TVV and line coupling
- Calibrated 19 step time-base with x10 magnifier
- Compact low-profile design

Affordable Spectrum Analyzers by B&K



500MHz Series

BK2615A \$1250
BK2620A \$1675

- 150KHz to 500MHz
- Dynamic Range 80dB(113dB with attenuation)
- +20dB maximum input
- 12.5 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2620A)

1.05GHz Series

BK2625A \$1925
BK2630A \$2595

- 150KHz to 1050MHz
- Dynamic Range 80dB(113dB with attenuation)
- AM & FM demod included
- 20 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator(Model 2630A)

PORTABLE SEMICONDUCTOR TESTER

B&K 510

\$199.00



- In or out-of-order circuit tests for transistor, FETs, SCRs and darlington.

20MHz Sweep / Function Generator with Freq Counter

B&K 4040

- 0.2Hz to 20MHz
- AM & FM modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep

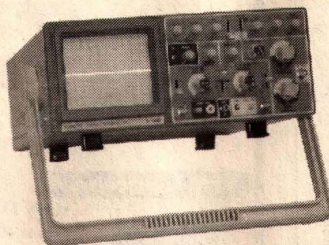
\$399

10MHz B&K 4017 \$309
5MHz B&K 4011 \$239



Quality Scopes by Elenco

Lowest Prices of the Year!



60MHz

DS-603 **\$995**

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

S-1360 **\$749**

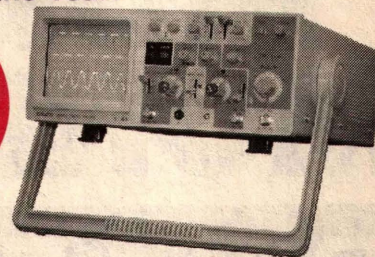
- Analog with Delayed Sweep
- Component Tester

100MHz

S-1390 **\$895**

- Analog w/ delayed sweep
- Dual Time Base
- TV Sync

Includes
Free Dust
Cover and
Probes



25/30MHz

DS-303 30MHz **\$895**

- Analog / Digital Storage
- 20MS/s Sampling Rate
- RS232 Output

DS-203 20MHz **\$695**

- Analog / Digital Storage

S-1330 **\$439**

- 25MHz Analog
- Delayed Sweep

S-1325 **\$325**

- 25MHz Analog
- TV Sync
- 1mV Sensitivity

**2 Year
Warranty**

Fluke Multimeter Specials



F-73III

\$119

List
\$135



F-75II

\$129

List
\$149



F-79II

\$175

List
\$199



F-87

\$289

List
\$335

B&K Precision Multimeter Specials



- Accurately measures capacitance, resistance and inductance.
- Measures dissipation factor of capacitors and Q of inductors.
- Simultaneously displays measured value and Q or dissipation factor.
- Displays the difference between measures and reference values.

Model 878

\$219.95



- 50,000 count
- 0.025% DCV
- 0.07% ohms
- Min/Max/Avg
- True RMS, AC, or AC+DC
- 100kHz AC response
- Capacitance to 50,000µF
- Frequency, duty cycle, pulse width
- dB across 1Ω to 10kΩ

Model 5390

\$295.00

MX-9300

Four Functions in One Instrument

Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply
- 0-30V @ 3A, 15V @ 1A, 5V @ 2A



\$459.95

GUARANTEED LOWEST PRICES

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



**15 DAY MONEY BACK
GUARANTEE**

FULL FACTORY WARRANTY
PRICES SUBJECT TO CHANGE WITHOUT NOTICE
Most Major Credit Cards Accepted

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!



No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio-TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! **GUARANTEED PASS**—You get your FCC License or money refunded. **Send for FREE facts now. MAIL COUPON TODAY!**

Or, Call 1-800-932-4268 Ext. 210

COMMAND PRODUCTIONS

FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

RF Data Modules

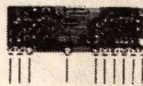
AM Transmitter



- Sub Miniature module
- SAW Controlled
- No adjustable components
- Low current - 2.5mA
- Supply 2.5-12Vdc
- 418MHz or 433MHz
- Range up to 300ft
- CMOS/TTL data input
- 7 x 11 x 4mm !

AM-TX1-xxx \$12.60

AM Receiver



- Compact Hybrid Module
- Very stable
- CMOS/TTL output
- Patented Laser Trimmed
- 5Vdc, 0.8mA (HRR6)
- 2kHz data rate
- Sensitivity -105dBm
- 38 x 12 x 2 mm

AM-HRR6-xxx... \$16.33

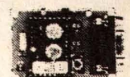
FM Transceiver



- Only 23 x 33 x 11mm
- Up to 40,000bps data rate
- Up to 450ft. range.
- 5V operation
- 418MHz or 433MHz FM
- 5V CMOS logic interface
- Fast 1mS enable
- Power saving feature
- Carrier Detect output

BiM-xxx-F \$87.36

RS232 Transceiver



- 3wire RS232 interface
- 19.2Kbps half duplex
- 418MHz or 433MHz FM
- 7.5-15Vdc, 20mA
- TX/RX Status LED's
- Up to 400ft. range
- 1/4 wave ant. on board
- User data packetizing
- 58 x 40 x 15mm

CYPHERNET \$139.30

AM Transmitter



- Range up to 250ft.
- SAW controlled stability
- Wide supply range 2-14V
- CMOS/TTL input
- Low current, 4mA typ.
- Up to 4kHz data rate
- Small: 17 x 11mm

AM-RT5-xxx \$12.10



ABACOM
TECHNOLOGIES



tel: (416)236 3858

fax: (416)236 8866

www.abacom-tech.com

MasterCard / VISA



PCB Artwork
Made Easy!

PRINTED CIRCUIT DESIGN SOFTWARE

For Windows and DOS

Layout - Autorouting - Schematic - Circuit Simulation

- * NEW 32 bit version available
- * Ripup and Retry Router in Advanced Pkg.
- * Copper Flooding for Building Ground Areas
- * Gerber and Excellon Output
- * Create Negative & Positive Printouts
- * Create Single or Multi Layer Boards
- * Create artwork from the Schematic
- * Analog and Digital Simulation available
- * Make boards up to 32" x 32"
- * Parts Libraries - Silk Layers - Solder Mask
- * Great for All Circuit Design Projects!
- * For the Professional and Hobbyist!

Download DEMO - www.pcboards.net

Windows LAYOUT pgm. starts at

\$149

Windows Pkg. layout-schematic-router

\$399

Call or Write for Full Product Line, Prices & Free Demo

PCBoards

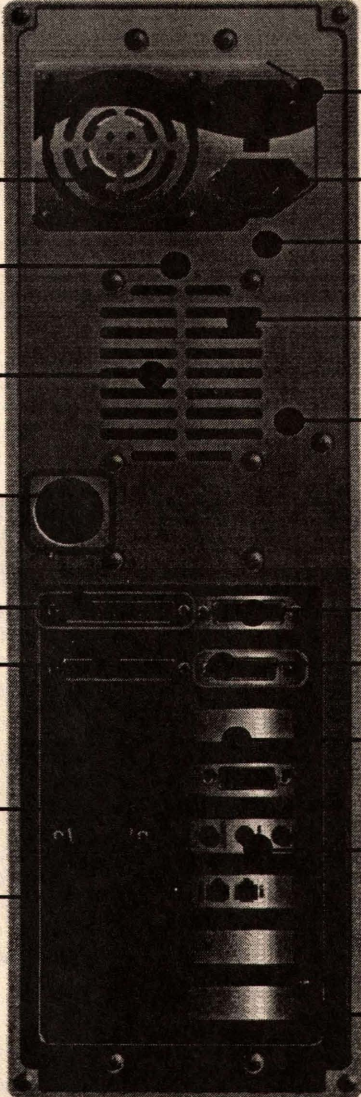
(800)473-7227

2110 14th Ave. South
Birmingham, AL 35206

Fax (205)933-2954
Phone (205)933-1122

If its on your computer you can find it at Roger's...

For Less!



3 1/8 Ball Bearing Power Supply Fans \$3.00 ea.	Knurled Brass Thumbscrews for Cases \$.25 ea.
230 watt computer power supply \$20.50 ea.	6' Monitor Power Cords \$2.00 ea.
3 1/8" Ball Bearing Case Fan \$7.00 ea.	6' Computer Power Cords \$2.00 ea.
5-pin AT to PS/2 keyboard adapters \$1.75 ea.	Fan Mounting Screws 10/\$1.00
DB Nut Male Stud w/ Washers, and nuts \$1.00/bag	AT Medium Tower Case, 7 bays \$51.30
DB25 Parallel Ports to Motherboard \$1.50	I/O Serial Parallel Cards- Hi-Speed Serial Multi-IRQ, 16-bit \$8.50
Full Duplex 3-D ISA Sound Cards \$12.00 ea.	DB9 Serial Ports to Motherboard \$1.50
Blank Slot Bracket \$.25 ea.	AGP 4MB SGRAM 3D 64 bit Video Card \$34.00
	Voice Fax Modem 56k V.90 PCI \$54.00
	Phillips Head Case Screws and Other Common Computer Screws \$2.00/bag

Roger's Systems Specialist



www.rogerssystems.com

CIRCLE 216 ON FREE INFORMATION CARD

Any waveform you want!



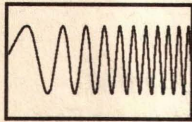
Starting at

\$795

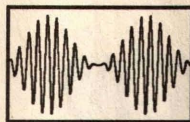
Quantity 1

Money back
guarantee

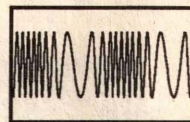
Telulex Inc. model SG-100



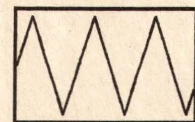
DC to 20 MHz linear
and log sweeps



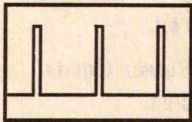
Int/Ext AM, SSB,
Dualtone Gen.



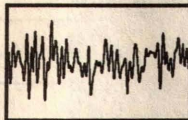
Int/Ext FM, PM,
BPSK, Burst



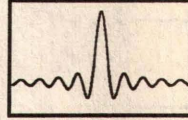
Ramps, Triangles,
Exponentials



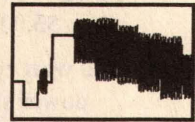
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

● Synthesized Signal Generator

Clean sinewaves DC-20 MHz with .001% accuracy!
.1 Hz steps. DC Offset. RS232 remote control.

● Arbitrary Waveform Generator

40 Megasamples/Second. 32,768 points. 12 bit DAC

● Function Generator

Ramps, Triangles, Exponentials & more to 2 MHz!

● Pulse Generator

Digital waveforms with adjustable duty cycle

Telulex Inc.

2455 Old Middlefield Way S Tel (650) 938-0240 <http://www.Telulex.com>

Mountain View, CA 94043 Fax (650) 938-0241 Email: sales@Telulex.com

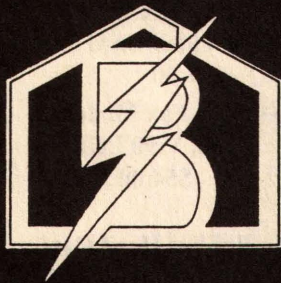
CIRCLE 311 ON FREE INFORMATION CARD

❖ ATTENTION CABLE VIEWERS ❖

CABLE VIEWERS. . .get back to your BASIC Cable Needs

Call 800-577-8775

For information regarding all of your **BASIC** cable needs.



**BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION**

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

❖ PRICE

❖ EFFICIENT SALES AND SERVICE

❖ WE SPECIALIZE IN 5, 10 LOT PRICING

❖ ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)

❖ **ANY SIZE** ORDER FILLED WITH SAME DAY SHIPPING

We handle **NEW** equipment **ONLY** - Don't trust last year's **OBSOLETE** and **UNSOLD** stock!
COMPETITIVE PRICING—DEALERS WELCOME

HOURS: Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
*Refer to sales personnel for specifications.

P.O. Box 8180 ■ Bartlett, IL 60103 ■ 800-577-8775

Sun Equipment Corporation Since 1988

P. O. Box 97903, Raleigh, NC 27624 E-mail: sunequipco@ipass.net
To request FREE CATALOG, please call, fax, write, or e-mail us.

Quality Test Equipment for Professionals



1 Year Warranty. 15 Day Money Back Guarantee.
School purchase order accepted. Bids accepted.
DEALERS & SALES REPS WELCOME.
DISTRIBUTOR & OEM WELCOME.

LODESTAR VISA, Mastercard, Discover, AmrExpress
1-800-870-1955 / (919)870-1955 Fax: (919)870-5720

DC POWER SUPPLY (CC/CV)

All models: protection of short ckt, overload, reverse polarity, over-voltage; Constant Current & Voltage (CC/CV) are fully adjustable. Regulation: $\pm 0.1\% + 3mV$ (line); $\pm 0.1\% + 3mV$ (load); $\pm 1mV$ ripple.

SINGLE OUTPUT

Analog Displays

PS-303 \$159.00, 30V/3A.
PS-305 \$219.95, 30V/5A.
PS-1610S \$289.00, 16V/10A.
PS-2243 \$139.00, 12V/24V select, 3A.
PS-2245 \$159.00, 12V/24V select, 5A.
8107 \$399.95, 30V/10A.
8110 \$289.95, 60V/3A.
8112 \$399.95, 60V/5A.

Digital Voltmeter & Analog Ammeter

8200(8201) \$179.95(\$239.95), 30V/3A(5A).
Digital Displays 8210/8300 \$199.95, 30V/3A.
8211/8301 \$259.95, 30V/5A.

DUAL OUTPUTS

Independent/Tracking

Analog Displays

8108 \$549.95, 60V/3A.
8109 \$699.95, 60V/5A.
PS-303D \$314.95, 30V/3A. PS-305D \$399.95, 30V/5A.

TRIPLE OUTPUTS, a fixed 5V/3A output, Independent/Tracking
Digital Displays 8202(8203) \$499.95(\$549.95), dual 30V/3A(5A).
Analog Displays 8102(8103) \$399.95(\$489.95), dual 30V/3A(5A), with Parallel (30V/6A) and Series (60V/3A) Mode operation.

NTSC/PAL TV COLOR BAR GEN.

CPG-1366A \$159.95, VHF NTSC;
Freq: 45.75, 175.25, 187.25 MHz;
RF Output: 10mV.
Impedance: 75 Ohm;
Video Output: BNC, 1V_{p-p}.
CPG-1367A \$159.95, VHF PAL.

SWR/RF/mW POWER METER

310 \$89.95, 1.8-150MHz, RF Power:
0-4W/20W/200W 3 ranges; SWR
Measurement: 1.0-∞, 4W minimum.
Accuracy: 5%-10%; Insert Loss: .3dB
Input/Output Imp: 50Ω; SO-239 plug
320 \$89.95, 130-520MHz. Spec. 310.

330 \$119.95, 1.8-520MHz. Spec. 310.

SWR-3P \$26.95 1.7-150MHz;

RF Power: 0.5-10W, 0.5W-100W.

SWR-2P \$22.95, 1.7-30MHz; RF Power: 0.5-10W.

mW RF Power Meter 340 \$219.00, 1.8-500MHz, RF
Power: 20mW/200mW/2W 3 ranges; Imped: 50Ω; Accuracy:
±10% full scale; SWR <1.15; N-type connector, BNC type output.

FM STEREO MODULATOR

AG-2011A \$549.00

RF SECTION:

Carrier: 98MHz±2MHz;

Output: 10mV, 1mV & 0.1mV

COMPOSITE SIGNALS:

Pilot: 19KHz±2Hz, 0.8Vrms

INT. MODULATION: 400KHz,

1KHz±1%, 1Vrms, distortion < .5% L-R Separation: >50dB.

EXT. MODULATION: Freq.: 50Hz-15KHz

L-R Separation: >45dB 100Hz-3KHz; >35dB 50Hz-15KHz.

WOW-FLUTTER METER

WF-3103A \$699.95 Freq. Range: 3KHz±10% JIS/CCIR;

3.15KHz±10% DIN.

Measuremt.: .03/1/3/31/3% full scale.

Accuracy: ±5% of full scale.

WF-3105A \$799.95, digital display;

Function: LIN/WOW/Flutter/WT.D.

Freq. Counter: 10Hz-9.99MHz.

Indication: CCIR/DIN/JIS.

TOOLKITS - ELECTRONIC/PC

924S \$29.99 U.S. Patented, 45-pcs. Contents: IC inserter/extractor with securers & bows, 3-prong part retriever, #0 Phillips screwdriver, 1/8" flat screwdriver, self-hold tweezers, metal tweezers, extra parts tube, soldering iron, solder, crimping tool, long-nose plier, cutting plier, zipper vinyl case. Bits include: Phillips: #0/#1/#2/#3; Flat: 1/8"/3/16"/1/4"/9/32"; PZ1/PZ2; T8/T9/T10/T15/T20/T25/T27/T30/T40/T45; Hex: 5/64"/3/32"/1/8"/5/32"/3/16"; Sockets: 3/16" (5mm)/7/32" (5.5mm)/1/4" (6mm)/9/32" (7mm)/5/16" (8mm).

82G23 \$34.99 23-pcs Contents: IC inserter/extractor with securer & bows, 3-prong part retriever, 3/16"/1/4" nutdriver, 3/16"/1/8" slotted screwdriver, #0/#1 Phillips, reversible T10/T15 bits, re-versible #2 Phillips/1/4" slotted bits, tweezer, long-nose plier, cutter, 6" adj. wrench, soldering iron, solder, crimping tool, zipper case, manual.

Various packages available, call/write to mail/fax for detail.

RF SIGNAL GENERATOR



SG-4160B \$124.95, 100KHz-150MHz up to 450MHz on 3rd harmonics in 6 ranges; AM modulation; Accuracy: ±5%. RF Output: 100mVrms to 35 MHz; Modulation: Int. 1KHz (AM) = 30%; Ext. 50Hz-20KHz, at least 1V_{rms} input. Audio Output: 1KHz, 2V_{rms} minimum.

SG-4162AD (with Freq. Counter) \$229.95, Spec. see SG-4160B.
COUNTER SECTION: 10Hz-150MHz; Max. Input: ±3V effective Gate Time: .1, 1sec. Input Sensitivity: 35mV, 10Hz-200MHz. Input Impedance: 1MΩ(HF), 50Ω(VHF). Display: 7-digit LEDs.

AM/FM STD SIGNAL GEN.

SG-4110A \$1799.00, Freq: 0.1-110MHz; Display: 6-digit LED; Resolution: 100Hz (0.1-34.999MHz); 1KHz (35MHz-110MHz). Accuracy: $\pm(5 \times 10^{-7} \pm 1 \text{ count})$; Output: -19dBu-99dBu, 1dB steps. Impedance: 50Ω VSWR 1.2; 100 preset frequency & store functions.

AUDIO GENERATOR

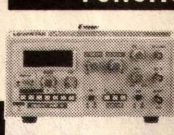


AG-2601A \$124.95, 10Hz-1MHz in 5 ranges; Output: sine wave 0-8V_{rms}; square 10V_{p-p}. Output Imped: 600 Ohm. Distortion: <0.05% 500Hz-50KHz; <0.5% 50KHz-500KHz.

AG-2603AD \$229.95, with 6-digit, Int/Ext. Freq. Counter, 10Hz-150MHz.

Output Control: 0/20-40dB & Fine adjust. Spec. see AG-2601A.

FUNCTION GENERATOR



FG-2100A \$169.95, 0.2Hz-2MHz in 7 ranges; sine, square, triangle, pulse & Ramp; Output: 5mV_{p-p}-20V_{p-p}, 1% distortion. VCF: 0-10V/freq. to 1000:1.

FG-2102AD \$229.95 see FG-2100A;

4-digit counter display, TTL & CMOS outputs, 30ppm ±1 count accuracy.

FG-2020B \$159.00 0.5Hz-500KHz; Sine, Square, Triangle.

FG-2103 \$329.95, Digital sweep generator, 0.5Hz-5MHz in 7 ranges. Operating Mode: sweep, AM, gated burst, VCG.

Freq. Counter: Int. 0.5Hz-5MHz; Ext. 5Hz-10MHz.

FG-513 \$769.95, 13 MHz, Microprocessor embedded digital sweep;

Sine, Square, Triangle, Pulse, Ramp, TTL & DC; $\pm(0.1\% - 1 \text{ dgt})$.

Freq. Counter & TCXO: 5Hz-100MHz, 6.5 digits. x1/x20 attenuatn.

AC MILLIVOLT METER



MV-3100A \$159.95 wide band 5Hz-1MHz; 3 scales, mV, dB & dBm; 300μV-100V in 12 ranges, 10μV resolution; -70-40dB in 12 ranges, 0dB-1Vrms, 0dBm=0.775V; ±3% accuracy; Input impedance 10MΩ; Noise <2%. MV-3201B \$309.95 dual channels, simultaneous measurement.

OSCILLOSCOPES



OS-7305B \$249.00 DC-7MHz, 3" CRT; Horiz: .25V/div; 10Hz-100KHz in 4 ranges; Vert: 10mV/div; Int. & Ext. Sync.; Input: 1MΩ/35pF.

OS-7010A \$299.95 10MHz, 5" CRT,

Horz: 2V/div; Vert: 10mV-10V/div.

OS-622G \$389.95 20MHz, 2 CH X-Y

Alt trigger, trigger lock, hold OFF, TV

syn., 8x10 div., 1mV/div., Horiz: 2μs-5s/div; Vert: 1mV-5V/div.

OS-653G \$699.95 50MHz, 2 CH/delay sweep, Alt trigger, TV syn.

OS-6101G \$1499.95 100MHz, 4ch/8 traces, delay sweep, cursor

readout. 2 years warranty for OS-622G, OS-653G, & OS-6101G.

UHF ATTENUATORS

RT-8815U (50Ω) \$299.00 / RT-8817U (75Ω) \$299.00, 950MHz,

81dB, 0.5W max.; Steps: 1/2/3/5/10/20/20, 8 switches.

085E-2 (50Ω) \$399.00 / 087E-2 (75Ω) \$399.00, 950MHz, 81dB,

0.5W max.; Steps: 10dB+7.1dBx10, Electronic adjustment knob.

MICROPROCESSOR TRAINER



BGC-8088 \$699.00, learn computer theory. Excellent for school & individual who want to learn about ROM, RAM, I/O ports, programming, & run a 8088 Microprocessor. An easy to understand step-by-step manual guides you to achieve your goal. 56-key keyboard, LCD display, RS-232, UART...

GRID DIP METER

DM-4061 \$89.95 1.5-250MHz, 6 bands; 6 plug-in coils, 2 transistor, and 1 diode. Modulation: = 2KHz Sinewave. Crystal Oscillator: 1-15MHz. Wave absorption meter. 9VDC battery.

FREQUENCY COUNTER



FC-5250C \$119.95 10Hz-220MHz (HF) 10Hz-20MHz (VHF) 10-200MHz. GateTime: .1, 1sec. Max. Input: 10V_{p-p}. Input Sensitivity: 35mV/10Hz-200MHz. Input Imped: 1MΩ(HF), 50Ω(VHF). Display: 7-digit LEDs; 9V adapter (\$6).

FC-5260A \$129.95, 600MHz.

FC-5270 \$149.95, 1.2GHz/8-dgt.

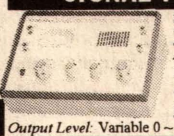
FC-5600 \$229.95, 600MHz/10-dgt.

FC-5700 \$299.95, 1.3GHz/10-dgt.

FC-1200 \$189.95, 1.25GHz/8-dgt LCD

Handheld; Microprocessor counter.

SIGNAL TRACER/INJECTOR



SE-6100 \$134.95
TRACER: Gain 60dB maximum. Attenuation: 0/20/40/60dB. Input Imped: 100KΩ; Meter: Vu 100μA. Output Imped: 600Ω; Speaker: 8 Ω.
INJECTOR: = 1KHz Squarewave; Output Level: Variable 0 - 4.5V_{p-p}; 9V battery or adapter (\$6.00).

LCR METERS

MIC-4070D \$179.95, Induct.: 0.1μ-200H, Capacit.: 0.1p-20mF, Resist.: 1mΩ-20MΩ, 2Q range, Dissipation factor measurement, Zero adjust; Surface mount device (SMD) test probe: LT-06 \$21.95

DIGITAL MULTIMETER



DMM-120 \$24.95, 3 1/2 digit, 600VDC, 2ADC 500VAC, 2MΩ, hFE/diode/continuity test, 1.2% DMM-1230+Cap+Freq \$59.95, 3 1/2 dgt, 200MHz 1000VDC/750VAC, 10ADC/AC, 20MΩ, 20μF, hFE/diode test, continuity beeper, 0.5% accuracy

DMM-1240+Cap+Freq+Logic \$69.95, Battery

check, Logic level measurement, + DMM-1230.

DMM-1250+Cap+Freq+Temp \$89.95, Battery

check, -58°-1999°F/-50°-1300°C, +DMM1230

DMM-125 \$54.95, Autorange/Bargraph, 32MΩ,

600VDC/AC, 10ADC/AC, diode/continuity test.

MIC-35 \$59.95, Autorange, 3 1/2 LCD, 20MΩ,

1000VDC/750VAC, 20ADC/AC, data hold,

diode/continuity test, free holster, 0.5% accuracy

MIC-39 \$129.95, Autorange/Bargraph, True RMS, 3 1/2 LCD, 40μF,

40MΩ, 1000VDC/750VAC, 20ADC/AC, 600KHz freq. cntr, data

hold, sleep mode, memory, read functions, holster, 0.3% accuracy.

POCKET ANALOG MULTIMETER AMM-9810P \$14.95

DCV: Range: 10/50/250/500V; ±4%.

ACV: Range: 50/250/500V; ±4%.

DCA: Range: 25mA, 250mA; Accuracy: ±4%

full scale; Protection: 0.5A/250V fuse.

Resistance: Range: 500kΩ (x 1k); ±5%.

dB Test: +4 to +56 dB on ACV range;

Accuracy: ±5% of full scale.

Battery Test: 1.5V and 9V.

Max. Input: 500VDC/AC, or 250mADC.

AUTO. CAPACITANCE METER

CM3300A \$139.00 10 ranges, 99.9pF - 99.9mF, fully automatic.

Resolution: 0.1pF lowest, 0.1% full scale.

Accuracy: 0.5% of full scale ±1 digit to 99.9μF,

1% of full scale ±1 digit to 99.9mF.

Display: 3 digit LED.

Unit: pF, nF, μF, mF, Overrange indicators.

AUTO DISTORTION METER

DM-3104A \$799.95

DISTORTION MEASURE

Range: 0.01% to 30%,

0.1/0.3/1/3/10/30% 6 ranges.

Freq: 400Hz±10%, 1KHz±10% (HPF).

Input: 3mV-100V; Ratio measure 20dB

Auto. Freq. Switching Ranges:

Fundamental Freq. = (fo)±5%; >70dB at (fo)±10%.

Fund. Rejection: >80dB at (fo)±5%; >70dB at (fo)±10%.

Harmonic Accuracy: ±0.5dB, 1.8(fo)-20KHz.

LEVEL MEASURE Range: 0 to 100V in .03/1/3/1/3/10/30/100V

Freq Response: ±0.5dB/20-50KHz; ±1dB/20-100KHz.

DM-3204 \$1,599.00 dual channels; Spec see DM-3104A.

USE ELECTRONICS NOW CLASSIFIEDS

READ BY ELECTRONIC BUYERS AND SELLERS AND TRADERS

INSTRUCTIONS FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy **CLEARLY** (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for each additional one (a photo copy of this form will work as well). Place a category number in the space at the top of the order form (special categories are available). If you do not specify a category, we will place your ad under miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. **PAYMENT IN FULL MUST ACCOMPANY YOUR ORDER.** We do permit repeat ads or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first word and company name of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is \$2.50 per word. Minimum charge is \$37.50 per ad per insertion (15 words). Any words that you want set in bold are each .40 extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged anything additional. State abbreviations must be post office 2-letter abbreviations. A phone number is one word.

If you use a Box number you must include your permanent address and phone number for our files. **ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.**

For firms or individuals offering Commercial products or Services. **Minimum 15 Words.** 5% discount for same ad in 6 issues within one year; 10% discount for same ad in 12 issues. **Boldface** (not available as all caps), add .40 per word additional. **Entire ad in boldface**, add 20%. **Tint screen behind entire ad**, add 25%. **Tint screen plus all boldface ad**, add 45%. **Expanded type ad**, add \$4.00 per word.

General Information: A copy of your ad must be in our hands by the 13th of the fourth month preceding the date of issue (i.e. Sept issue copy must be received by May 13th). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding work day. Send for the classified brochure.

DEADLINES

Ads not received by our closing date will run in the next issue. For example, ads received by November 13 will appear in the March issue that is on sale January 17. **ELECTRONICS NOW** is published monthly. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. **NO REFUNDS**, advertising credit only. No phone orders.

CONTENT

All classified advertising in **ELECTRONICS NOW** is limited to electronics items only. All ads are subject to the publishers' approval. **WE RESERVE THE RIGHT TO REJECT OR EDIT ALL ADS.**

AD RATES: \$2.50 per word, Minimum \$37.50

Send you ad payments to:

ELECTRONICS NOW 500 Bi-County Blvd, Farmingdale, NY 11735-3931

CATEGORIES

100 -- Antique Electronics
130 -- Audio-Video Lasers
160 -- Business Opportunities
190 -- Cable TV
210 -- CB-Scanners
240 -- Components

270 -- Computer Equipment Wanted
300 -- Computer Hardware
330 -- Computer Software
360 -- Education
390 -- FAX
420 -- Ham Gear For Sale

450 -- Ham Gear Wanted
480 -- Miscellaneous Electronics For Sale
510 -- Miscellaneous Electronics Wanted
540 -- Music & Accessories
570 -- Plans-Kits-Schematics
600 -- Publications

630 -- Repairs-Services
660 -- Satellite Equipment
690 -- Security
710 -- Telephone
720 -- Test Equipment
730 -- Wanted

CLASSIFIED AD COPY ORDER FORM

Place this ad in Category # _____

Special Category \$30.00 Additional _____

1 - \$37.50 2 - \$37.50 3 - \$37.50 4 - \$37.50

29 - \$72.50 30 - \$75.00 31 - \$77.50 32 - \$80.00

5 - \$37.50 6 - \$37.50 7 - \$37.50 8 - \$37.50

33 - \$82.50 34 - \$85.00 35 - \$87.50 36 - \$90.00

9 - \$37.50 10 - \$37.50 11 - \$37.50 12 - \$37.50

37 - \$92.50 38 - \$95.00 39 - \$97.50 40 - \$100.00

13 - \$37.50 14 - \$37.50 15 - \$37.50 16 - \$40.00

Total words _____ \$2.50 per word = \$ _____

17 - \$42.50 18 - \$45.00 19 - \$47.50 20 - \$50.00

Bold Face _____ \$0.40 per word = \$ _____

21 - \$52.50 22 - \$55.00 23 - \$57.50 24 - \$60.00

Special Heading _____ \$30.00 = \$ _____

25 - \$62.50 26 - \$65.00 27 - \$67.50 28 - \$70.00

Other _____ = \$ _____

Total classified ad payment \$ _____ enclosed

TOTAL COST OF AD \$ _____

☐ Check ☐ Mastercard ☐ Visa ☐ Discover

Card # _____ Expiration Date ____/____

Signature _____

Name _____ Phone _____

Address _____ City State Zip _____

ALL ELECTRONICS

C O R P O R A T I O N

QUALITY PARTS

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX
or E-MAIL For A
Free 96 Page
CATALOG.
Outside the U.S.A.
send \$3.00 postage.

9 Volt Style Nickel-Cadmium Rechargeable Battery

Sanyo "Rechargacell"™ # N-6PT
7.2 v 120 mA battery
for 9 Volt applications.

\$2.00
each

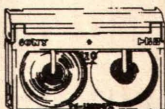
CAT# NCB-91

10 for \$30.00



"Hi-8" Video Cassette

SONY Hi-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box.



\$3.00
each

CAT # VCU-8

10 for \$28.00 • 100 for \$250.00

3 Volt 35 mAh Lithium Coin Cell

Sony CR1220
3 Volt, 35 mAh. 0.48" (12 mm)
diameter x 0.08" (2 mm) thick. Fresh,
1997 date code. Large quantity available.

CAT # LBAT-19

2 for \$1.00

100 for \$35.00 • 1000 for \$200.00

Surface mount holders
available for coin cells.

Resettable Circuit Protector 0.65 - 1.3 Amp

Raychem "Polyswitch" # RXE-065S-1
General purpose circuit protectors for
power supplies, alarm systems, speakers,
motors etc. Unlike traditional fuses, they
automatically reset when fault condition is
cleared. Can be paralleled for higher ratings.
Current: 0.65 Amps. Trip Current: 1.3 Amps.
Max Voltage: 60 Volts. 0.33" diameter. UL,
CSA listed.

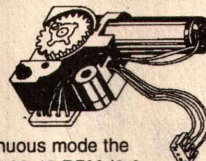
CAT # RXE-065

3 for \$1.00

100 for \$20.00 • 500 for \$85.00
1000 for \$150.00

Mini-Right Angle Gearhead Motor with Control Circuit

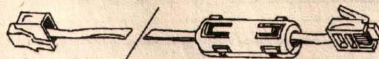
Omron # R2DG-41
These unusual little motors have built-in control circuits that allow them to be used in a continuous or a pulsed mode. In continuous mode the final drive gear turns at 22-45 RPM (3-6 Vdc). In the pulsed mode the final drive gear turns one revolution each time the controller is momentarily pulsed. The motor assembly is 1.75" x 1.25" x 0.5" overall. The nylon final gear is 0.62 diameter and has a little nipple slightly off-center to which a small push-rod could be attached. Motors are in good condition, removed from equipment. Hook-up instructions included.



CAT # DCM-110

\$7.50
each

7' Modular Phone Cord With Ferrite Bead



Standard RJ-11(4 pin) telephone cord with ferrite bead to reduce RFI interference. Bead is detachable if you want to use it in another application.

\$1.25
each

CAT # MT-260FB

10 for \$10.00
100 for \$85.00

Piezoelectric Element

1.32 DIAMETER X 0.16"

AVX/Kyocera # KBT-33RB-2CN

Metal encased piezoelectric acoustic generator. High durability. Small, thin shape. Designed for telephone use. Inside the metal case is a 1.28" diameter piezo element with 5.5" leads attached. If you're looking for a plain element with leads, the case can be pried apart fairly easily.

CAT# PE-39

2 for \$1.00

100 for \$40.00
1000 for \$250.00
(25¢ each)

Projection TV Lens

Mitsubishi # 490P15706

Originally for use in a three-gun TV projection system.

High-impact plastic lens housing and support bracket. 5.35" diameter x 2.92" long at maximum focal length. Lens can be disassembled to yield five elements including a 3.1" dia. glass concave / convex lens, a 2.93" diameter glass convex-convex lens and three plastic correction elements.

\$7.50
each

CAT # LNS-10

12 for \$72.00

S-VHS Tape (Used)



Super VHS tape users! Save a bundle on name-brand S-VHS, T-120 tapes. These tapes were used for a brief period, then bulk erased.

The record-protect tabs have been broken out, so you will have to cover the notch with a piece of tape, but they work great and cost a fraction of the "new" price. Try some, you'll be back for more.

CAT #S-VHS

\$3.00
each

10 for \$28.00 • 100 for \$250.00

Great Price! "EAR BUD" STEREO EARPHONES

Miniature "in-ear" ear-phones for use with most portable CD, radio and tape players. Gold-plated 3.5 mm stereo phone plug. 32 ohm impedance.

Large Quantity Available

CAT #HP-6

85¢ each

10 for \$7.50
100 for \$50.00



ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO:
ALL ELECTRONICS CORP.
P.O. BOX 567
VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524
INTERNET <http://www.allcorp.com/>
E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

January 1999, Electronics Now

Since 1971

www.WEB-TRONICS.com

Circuit Specialists Inc.

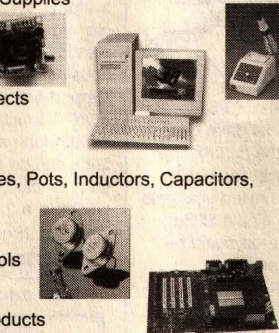
Check us last for the best deals on quality electronic parts, equipment & supplies!

- ♦ Easy to navigate site with loads of information
- ♦ Thousands of stock items
- ♦ Special deals found nowhere else
- ♦ New products added constantly
- ♦ Prices updated weekly on volatile computer products
- ♦ Order online, by FAX, by phone or snail mail

CCD Board Cameras & Surveillance Supplies
Printed Circuit Board Supplies
Computer Systems & Boards
Industrial Computer Products
NuDaq DAQ Boards!
All Kinds of Do It Yourself Kits & Projects
Super Test Equipment Deals!
Cabinet & Enclosures
Switches

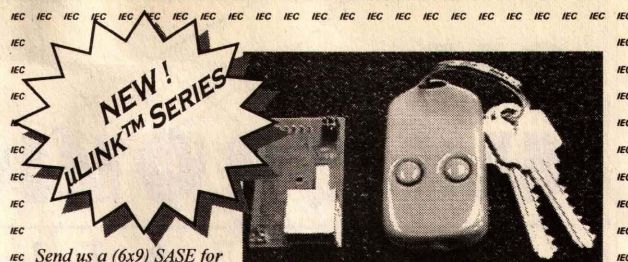
Passive Small Parts, Resistors, Diodes, Pots, Inductors, Capacitors, Lamps, LEDs, etc.
I.C.s

NTE Replacement Devices
Soldering Equipment & Electronic Tools
Prototyping & Breadboard Supplies
Connectors
Cable Ties, Heat Shrink & Wiring Products
Special Kitting Service for Educators
Lasers & Educational Laser Products
and much, much more!



Circuit Specialists, Inc.
800-811-5203
FAX 602-464-5824

You'll "Bookmark" This Site!



Send us a (6x9) SASE for your FREE catalog.

μLink™ Infrared Remote Control System

- 4 Channel IR Keychain Transmitter (pcb 1.1" x 1.2") IRTX4-A
- 4 Channel IR Receiver (pcb 1.1" x 1.9") IRRX4-A
- Each receiver can LEARN up to 4 transmitters.
- Each transmitter can have a different access level.
- User selectable receiver output modes.
- Security, Industrial and Home Control Applications
- Up to 9m Range.
- RX and TX IC's available. Custom design service available.

Only \$39.⁹⁵/pair + S&H, additional IRTX4-A units \$19.⁹⁵

SURFACE MOUNT KITS:

- Pager Decoder Interface
- Garage Door Openers

- PLL XTAL FM MIC
- LC tuned FM MIC
- Phone transmitters

Orders: 1-800-417-6689 Mon-Fri 9AM-6PM ET

visa/mastercard/money orders

email: iecorp@i-e-c.com

web: www.irmicrolink.com

IEC ♦ PO Box 52347 ♦ Knoxville TN 37950

COPYRIGHT ©1998 International Electronics Corp.

WIRELESS VIDEO CAMERAS

Compatible with AC or Battery



GFT-1001 \$189.95
Gives any camera the ability to be Wireless.
Transmits Over 1000 ft.

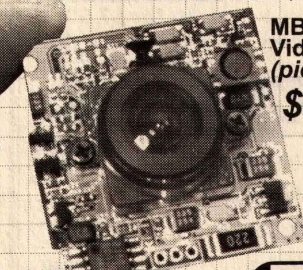
Wireless 4-Channel B/W & COLOR Cameras Available! Plug and Play Readiness



Wireless Observations System's
GFS-1001 (900MHz) - \$499.95
GFS-1001c (900MHz) - \$599.95
(1.2 Ghz system's available)

MB-750 SERIES BOARD CAMERAS

Pinhole • MB-750p - \$89.95
C-Mount • MB-750UX - \$119.95



MB-750U Video Camera (pictured) \$99.95



ODH-106

ODH-106 Board Camera Housing
4.5 x 2.75 x 2.75", High-Impact, Weatherproof, w/ 5.5" Arm.

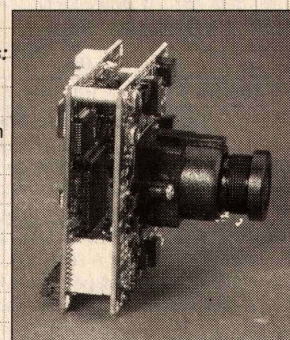
FREE
Polaris Product Catalogs

COLOR BOARD CAMERAS

Micro Color MB-960c Key Features:

- Lens: 3.6mm F=2
- Full Digital Process of BLC
- Auto Tracing White Balance
- 2H Mode of H.V. Aperture correction
- Digital process of color matrix
- Electronic Shutter up to 1/10,000
- *Dip Switch Adjustment settings:
6-BLC
5-Auto Shutter
4-AGC/On
3-Flickless
2-AWB/On
1-No function

MB-960c \$199.95



Size: 1.7 x 1.7 sq. x 2 PC Board



LP-850i Lipstick Camera \$129.95

NIGHT VISION



Other Models Available to Choose From!

Night Vision Scope w/ Illuminator
Fun to use, Low cost.
3.6 x 85mm f1.6
MI-PR100 - \$399.95

470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

CIRCLE 222 ON FREE INFORMATION CARD

2539 W. 237th Street, Bldg. F, Torrance, CA 90505
Order desk only: USA: (800) 872-8878 CA: (800) 223-9977
LA. & Technical Info: (310) 784-5488 Fax: (310) 784-7590
OEM INQUIRIES WELCOME

TIMELINE INC.

Over 13 years and 31,000 customers and still growing

Minimum Order: \$20.00. Minimum shipping and handling charge \$5.00. We accept cashiers checks, MC or VISA. No personal checks or COD's. CA residents add 8.25% sales tax. We are not responsible for typographical errors. All merchandise subject to prior sale. Phone orders welcome. Foreign orders require special handling. Prices subject to change without notice. 20% restocking fee for returned orders.

LIQUID CRYSTAL DISPLAYS

240x64 dot LCD with built-in controller.

AND 4021ST-EO. Unit is EL back-lit. \$59.⁰⁰ or 2 for \$109.⁰⁰ or OPTREX. DMF5005 (non back-lit) \$49.⁰⁰ or 2 for \$89.⁰⁰

20 character x 8 line 7/8L x 2 1/4H The built-in controller allows you to do text and graphics.

Alphanumeric—parallel interface

16x1.....\$7.00	20x2.....\$10.00	32x2.....\$8.00
16x1 (lg. char.).....\$10.00	20x4.....\$15.00	40x1.....\$8.00
16x2.....\$7.00	20x4 (lg. char.).....\$10.00	40x2.....2 for \$20.00
16x2 (lg. char.).....\$10.00	24x2.....\$10.00	40x4.....\$20.00
16x4.....\$15.00	32x4.....\$10.00	4x2.....\$5.00

5V power required • Built-in C-MOS LCD driver & controller • Easy "microprocessor" interface • 98 ASCII character generator • Certain models are backlit, call for more info.

Graphics and alphanumeric—serial interface

size	Mfr.	price	size	Mfr.	price
640x480 (backlit)	Epson	\$25.00	480x128	Hitachi	\$10.00
640x400 (backlit)	Panasonic	\$20.00	256x128	Epson	\$20.00
640x200	Toshiba	\$15.00	240x128 (backlit)	Optrex	\$20.00
480x128 (backlit)	ALPS	\$10.00	240x64	Epson	\$15.00
			160x128	Optrex	\$15.00

6" VGA LCD 640X480, Sanyo LMDK55-22 \$25⁰⁰

MONITORS

Non-Enclosed TTL

Comes with pinout. 12V at 1.4 Amp input • Horizontal frequency 15KHz. • Ability to do 40 and 80 column.

5 inch Amber \$25.00 • 7 inch Amber \$25.00

9 inch Amber or Green \$25.00

5" COLOR MONITOR \$39.⁰⁰

- Flat Faceplate • 320 x 200 Dot Resolution • CGA & Hercules Compatible
- 12 VDC Operation • 15.75 KHz Horiz. Freq. • 60 Hz Vert. Sync. Freq.
- Open Frame Construction • Standard Interface Connector • Degaussing Coil included • Mfr. Samtron

2 for \$69⁰⁰

9" COLOR SVGA MONITOR \$179.⁰⁰ Fully Enclosed - Tilt and swivel type.

POS & BAR CODE

MAGNETIC CARD READER \$25.⁰⁰

Includes: • 20 character dot matrix display with full alpha-numeric capability • keypad with full alpha-numeric entry • separate 7.5 VDC/0.5 Amp power supply • standard telephone interface extension cord • lithium battery and flat-cone speaker.

HP bar code wand (HBCS 2300) \$19.00

HACKER CORNER

EMBEDDED 486 COMPUTER \$99.⁰⁰

Complete enhanced Intel 486SX-33 based computer in ultra small (9-7/8L x 6-5/8W x 3-1/8H) case. Ideal for embedded operations or as a second computer. Features include: • One 16 bit ISA slot • 3 serial ports plus dedicated printer port • Parallel optical coupled adapter port • Built in IBM PC/AT keyboard port • On board VGA video and port • Uses standard SIMM up to 32 MB • BIOS is PC/AT compatible

Unit has a backup Ni-Cd battery system in case of power failure (5 min. backup time) and lockable front cover to prevent floppy drive access. Mounting / interface provisions for standard 3.5" laptop floppy and 2.5 inch hard drives. Comes with very comprehensive manual.

SONY Miniature Color LCD Display (LCX005BKB) \$29⁰⁰

• 1.4 CM (0.55 inch) Diagonal Full Color Display • Built In Horizontal and Vertical Drivers • Delta Dot Pattern for High Picture Quality - 537 dots (H) x 222 dots (V) • Compatible with NTSC & PAL Format and Sync Inputs • 12 VDC Operation with -1 to +17 V RGB Signal and Driver Input Voltage • Excellent Display for Virtual Reality Projects, Viewfinders, and Miniature Test Equipment Displays • Pin Outs and Specification Included • Unit Requires Clock, Synchronization and Video

CELL SITE TRANSCEIVER \$49.⁰⁰ 2 for \$89.⁰⁰

These transceivers were designed for operation in an AMPS (Advanced Mobile Phone Service) cell site. The 20 MHz bandwidth of the transceiver allows it to operate on all 666 channels allocated. The transmit channels are 870.030-889.980 MHz with the receive channels 45 MHz below those frequencies. A digital synthesizer is utilized to generate the selected frequency. Each unit contains two independent receivers to demodulate voice and data with a Receive Signal Strength Indicator (RSSI) circuit to select the one with the best signal strength. The transmitter provides a 1.5 watt modulated signal to drive an external power amplifier. Channel selection is accomplished with a 10 bit binary input via a connector on the back panel. Other interface requirements for operation are 26 VDC (unregulated) and an 18.990 MHz reference frequency for the digital synthesizer. The units contain independent boards for receivers, exciter, synthesizer, tunable front end, and interface assembly (which includes power supplies and voltage-controlled oscillator). Service manual, schematics and circuit descriptions included.

Encased Spread Spectrum RF Modem \$99.⁰⁰

The ProxLink Radio Module is a small communication device which replaces cables between RS-232 devices with wireless RF (Radio Frequency) technology. Attaching a pair of ProxLinks to any two devices with three wire asynchronous RS-232 ports allows wireless data transmission at rates up to 19.2 Kbaud (full duplex) over a range of 500 - 800 feet. Modules use 900 MZ spread spectrum radio for communication which does not require an FCC site license. A variety of configuration information (radio channel, baud rate, serial port configuration, etc.) can be programmed into module's non-volatile memory by host PC to provide compatibility and avoid overlapping systems. Configuration changes are supported by menu driven, on-board software. Commonly used Terminal Emulation software and transfer protocols can be used for configuring modules and transferring data between computers. ProxLinks require only 6-9 VDC (350 mA), RS-232 (9 pin sub-D) interface, and small (~4") whip antenna for operation. Unit size is 4.0" x 6.5" x 0.75". Installation schematics and application details available. These are 100 Mw power.

COLOR CCD CAMERA \$89.⁰⁰

Small fully enclosed color CCD camera ideally suited for video conference and mobile operations. No separate power supply or batteries needed - single 5 VDC power requirement can be obtained from PC keyboard interface or directly from the computer using the included adapter plugs. Standard NTSC composite output from 1/4" color CCD sensor with 250,000 pixels and automatic white balance.

CIRCLE 275 ON FREE INFORMATION CARD

Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.⁰⁰



PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$89.⁰⁰

Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 \$99.⁰⁰

Call for your FREE Catalog
Graymark®

P.O. Box 2015 Tustin, CA 92781
<http://www.labvolt.com>

CIRCLE 329 ON FREE INFORMATION CARD

PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 \$198.⁰⁰



CALL TODAY!
800-854-7393



HAPPY NEW YEAR

SUPER! UNDERWATER (to 60 ft.) "LIPSTICK" CAMERA with INTEGRAL INFRA-RED ILLUMINATOR!

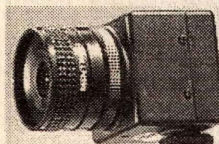


Sleek black anodized, BRASS, housing is O-Ring sealed & **WATERPROOF**. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 3.6mm, 92° FOV glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only: 1.25" d. X

2" long. With 60 ft. cable. Great for gen'l outdoor use also. **GM-300K...\$199**

TWO MINI C-MOUNT CAMERAS, Super sensitive, GM410 or the general purpose GM412, The GM-412 specs: B&W, size 1.5" sq. X

2.4"L, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux, The GM410 specs:



size only 1.5" SQ. x 1.6"L. >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX., Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE, BNC video out, Both use std. DC pwr. jack. Aluminum housings with dual threaded top and bottom mounting.

• True performance not hype! These cameras will outperform ANY camera in this magazine. Multi-lens options are available.

GM412, less lens...\$119, GM410, less lens...\$169

C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE: Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV	\$39	4mm, 80° FOV	\$24
8mm, f1.3, 44° FOV	\$49	8mm, 40° FOV	\$24
4mm, f1.4, 78° FOV	\$49	12mm, 28° FOV	\$24

PRICE BUSTER, DSP, COLOR, MINI C-MOUNT, CAMERA,



Brand New, model GM859, Size only: 2" x 2" x 2.5"L, Latest 1/4" CCD technology. Res. 350 lines, sens., <3lux, auto white balance, AGC. Auto iris connector. 9-12VDC @150ma power. BNC video out. Switchable gain. Superior cast aluminum housing with top and bottom mounting. Perfect for general surveillance. Less lens. Lens options above.

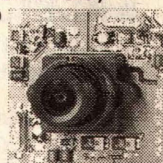
Reg. \$299 Save \$110, **GM859.....\$189**

PRICE BUSTER, DSP, COLOR BOARD CAMERA TOO,

Brand New, model GM550, Size: 1.6" x 1.6" x 1.5"L, 1/3" CCD with SONY CCD & DSP technology. 4mm, f1.8 glass lens, 80° FOV. Resolution >350 lines, sensitivity, 0.3lux, AWB, AGC & auto electronic shutter 1/60 to 1/10,000 sec. Pwr. 12VDC @160ma. NTSC out. Budget color surveillance.

Reg. \$269, **SPECIAL, GM550-STD.....\$149ea.**

GM550-Pinhole....\$149ea.



CHECK THIS! ULTRA MINI and WEATHERPROOF!



Our "LIPSTICK" camera sets new standards.

Sleek black anodized, aluminum, housing is O-Ring sealed & **RAINPROOF**. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 12VDC @100mA, 3.7mm, 90° FOV lens. A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" leads. **GM-200KSTD..\$119, AC pwr...\$4.95**

PINHOLE LENS, "BULLET CAM"

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. **GM-200KPH lens....\$129**

NEW MICRO CAMERA, w/audio 1/3" CCD, 410

Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25" sq. x 1" d. PH is 0.6" d, Both with 6" leads.

WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS.

GM-1000A-STD.....\$79	GM-1000A-STD/Audio.....\$84
GM-1000A-PINHOLE.....\$79	GM-1000A-PH/Audio.....\$84
GM-1000A-C-MOUNT...\$79	GM-1000A-CMNT/Audio..\$84

Micro Lenses for GM1000 series

2.5mm, 150°.....\$22	8.0mm, f2.0.....\$22
4.3mm, 78° f1.8.....\$22	12.0mm, f2.0.....\$22
6.0mm, f2.0.....\$22	5mm, 70°PH.....\$22

PRICE BUSTER...GM8-BQ, 2- PAGE REAL TIME, VIDEO QUAD

This system offers 4 or 8 camera inputs. Full screen image, single or dual-page REAL TIME quad display, super resolution: 960x480, Independent brightness adj. for each chan. Alarm time (1-20 sec.) Auto Sequencing w/ith adj. dwell: 1-4 sec. User-friendly. Quality video processing at a remarkable price. • 8 video inputs. • 1 monitor out & 1 quad out. • Single page or dual page switch. • 8 alarm inputs • Buzzer • 2 Alarm Out • Dim: 239 x166 x55 mm. **SPECIAL! GM8-BQ....\$299ea.**



Brand New, Video Motion Sensor. Model

VM-10. Attach to any std. video signal and you've got an electronic "watchman" diligently watching the entire scene. Or an adjustable sized area within the scene, such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac pwr. Adjustable sensitivity. Video loop through. **VM-10.....\$189**

END FIELD of VIEW GUESSWORK, 3.5 - 8mm VARI - FOCAL LENS. New, super f1.8

lens allows adjustment from a 97° FOV @ 3.5mm to a 44° FOV @ 8mm. Frame your area of interest just the way you want it! Or use it to select a fixed lens of the desired field of view. Either way a handy item to have. Standard C-Mount with adjustable focus and iris. **\$99ea. 2 for \$189**



MOTORIZED ZOOM LENSES,

Up to 20X mag. (w/extender) and auto iris too!

New, fabulous hi-res. optics with std. C-Mount. Superior Fujinon and Vicon lenses. Normally cost from \$600 to \$1500. There is no substitute for a good lens! All motors will operate from 6-12VDC. The Auto iris models have a built in amp which uses the camera video output for control. They will work with any camera whether or not it has an "auto iris" connector. Units available with OPTICAL ENCODERS for position pre-set as well. ADD \$99.

Type A-10, 11 to 110mm, 10X, f1.8, w/AI	\$349
Type B-6, 12.5 to 75mm, 6X, f1.2.....	\$199
Zoom Lens Controller, NEW.....	\$169
TELE- EXTENDER multiplies the basic magnification of the lens X2! Screws in between camera and lens. Converts 6X & 10X to 12X or 20X.....	\$89ea.

WORLDS SMALLEST

100mW, VIDEO TRANSMITTER,

Incredibly only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for.

Shown actual size. Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned ready to receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV included. Perfect with our GM1000A cameras. Both will fit in a cigarette pack...with the battery! The best deal anywhere. **TVX-100.....\$189** with **GM1000A-PH CAM.....\$268**



Please fax us your list of unique surplus material.



RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL unltd4u@tiac.net

CIRCLE 283 ON FREE INFORMATION CARD

PARTY LIKE IT'S 1999!

FOR THOSE WHO SEEK POWER.....

DUAL DC PWR SUPPLY DELIVERS up to 400Watts

Like new, Vicor "FLATPAC" model VI-PF01-CUU, 12V@16A & 5V@40A with cooling. Universal AC input accepts from 90-270VAC. BUS & AC, OK status out. Agency approvals. Fully protected: I limit, Short circuit, OVP & overtemp. Current sense and V trim pins. Size: 9.3"x5"x1.4"

Reg...\$400 Our Price.....\$39



MERCURY SHORT ARC LAMPS

Provide intense UV and visible illumination.



Brand new types available: OSRAM HBO 1003/PI, 1000W (left)...\$149ea.
OSRAM HBO 1500W/PI, 1500W (left)...\$199ea.

One used model: ILC MSH 10003GI, 1000W (right).....\$49ea. Limited quantity.



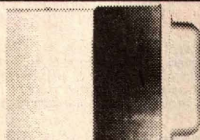
MERCURY DISPLACEMENT RELAY,

Dayton 6X598 Hermetic, class "B" Coil Volts: 120VAC, AC contact rating: 35Amps @480V, Tungsten 35A@120V, NEW, BOXED w/data. Special.....\$10ea or 2/\$15

STEP DOWN TRANSFORMER 220/240 to 120VAC @ 1.5KVA

Heavy duty. Brand New, Size: 11"x7W"x6"D
Weight: 41lbs. NEMA 3 BOX. Single Phase.

List price \$185 PRICE.....\$29ea.



FIVE OUTPUT POWER SUPPLY

Power anything you can dream up. New, Elpac 1822, attractive brushed steel & black enclosure. Industrial quality with five individually fused outputs: +5VDC @ 2.5Amps, ±12VDC @ 0.5Amps, ±20VDC @ 2.5Amps. Trimmer externally adjusts up to ±15 and ±24VDC. Operates from 110VAC or 220VAC. Size: 6"H x 8"W x 16"D. \$24.95ea. or 3/\$59



HIGH POWER BLOWER! AMETEK type, 117643-01 or 116643-02

240VAC @2.5A or 120VAC @4A bypass, brushless type with isolated speed control. With a 0 to 10VDC signal applied to the control pin blower speed varies from 0 to 100%. Produces up to 120CFM. Can operate with static pressures up to 25" H₂O. Size: 5.9" diam x 5.2" w. With 1.75" O.D. output port.

Specify Voltage. Reg. Price \$165 NOW....\$39ea. or 2 for \$69

10V @ 2.5 AH SEALED, LEAD ACID, PACK

Each pack consists of five, 2 Volt cells. Each cell the size of a std. 'D' battery. Arranged as 1X5 cells. Enclosed in an ABS outer shell. (removed for photo) Mint condition. Perfect for high drain and robotics applications. Make custom packs of any rating. Size: 7.5"L x 2.8"H x 1.5"D 5-five packs\$20, 30 for \$99



YOU CAN NEVER BE TOO THIN

or TOO POWERFUL. Unique "Thinline Energy Cell from Portable Energy Products. Their model PLA02V50. Super thin, high performance, patented technology. RECHARGEABLE sealed lead acid battery. Each cell is 2V@5AH. Size an amazing 3.1" x 5.3" x 0.3" thick! Mount in any orientation. Line the bottom of a briefcase or covertly wear on the body. 30% higher energy density than conventional lead acid batteries. SPECIAL 6 cells \$15 or 24 for \$49



XENON STROBE FLASH, From Polaroid. High quality & power!

Oversize flash tube produces 20 JOULES! Trigger with DC signal or switch closure. Self contained, internal 4AA battery compartment. NEW. 3 for \$10 or Case of 10 for \$20



NEW BNC "T" adapter, male to dual female.

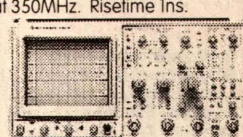
Deluxe model with insulated outer shroud. (Standard BNC 'T' Only completely insulated! 4 for \$5 or 20 for \$20



TEK 2465A/DM, 350 MHz, 4Chan. O'scope with DMM

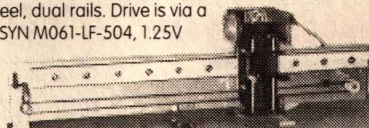
Super 350 MHz four-channel scope. Sens: 2 mV at 350MHz. Risetime 1ns.

Sweep: 500ps/Div. Voltage & Time cursors, screen readout. 1 Mohm /50-ohm input. Digitize, store and recall waveforms. Auto Setup, Sequencing & more. Accessories: 10X Probes (2), Pouch, Ops Manual, Cover. Opt.01 = Digital Multimeter. Option 09 = Counter/Timer/Trigger and Word Recognizer. Mint. TEKTRONIX 2465A/DM..... \$2695



LENGTHLY LINEAR SLIDE, CAN GIVE YOU A LIFT as WELL!

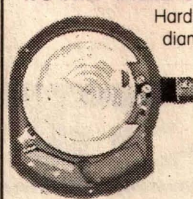
Four different lengths available, all with similar construction. All units based on a heavy duty 1.5" wide, stainless steel, dual rails. Drive is via a toothed belt, powered by a SLO-SYN M061-LF-504, 1.25V @3.8A stepper motor with 200 steps per rev and 60 oz. in. hold. The "Medium unit" shown right, also includes a precise Z



axis drive, providing 3.5 inches of precise travel by virtue of its' 4:1 ratio toothed belt drive. Powered is by another M061-LF-504 stepper. The remaining three lengths have no Z drive. All units incorporate a superior quality, recirculating ball bearing slide with 3" x 3" x 1/2" thick mounting plate. "Z" unit size: 7"H x 2.5"W x 5.75D Very limited quantity. Also the "short" slide is mounted on a 1/4" thick anodized alum. plate. All have been carefully removed for precision optical equipment. The dimensions and travels are listed below:

Model	Travel	Rail L"	Weight	Overall Size	PRICE
Ex Long:	46"	49"	12lbs.	51"L x 5"W x 3.5"H	\$149ea. or \$269 for pair.
Long:	30"	33"	9lbs.	39"L x 5"W x 3.5"H	\$129ea. or \$229 for pair.
Med w/Z:	20"	23"	12lbs.	24"L x 2"W x 4.6"H	\$139ea. or \$249 for pair.
Short:	11.5"	16"	7lbs.	16"L x 4"W x 6.5"H	\$69ea. or \$119 for pair.

ROTARY TABLE OFFERS PRECISE .002 deg. RESOLUTION



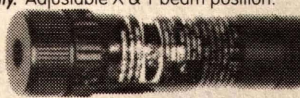
Hard to find rotary motion base. This 13lb. unit includes a 9.25" diameter anodized aluminum platter with a toothed outside diameter. A toothed belt surrounds the O.D. and is driven by a 1/2" diam. toothed pulley attached to the output of a Bayside 5:1 ratio, right angle drive, powered by a Slosyn, M061-LF-504, 1.25V, 3.8A, 200 step per rev., 60 oz/in. stepper motor. By our estimate this should equate to about an 18500:1 final drive ratio! or about 0.0195 deg. per full step! Overall size is: 14.5"W x 17"L x 4.75"H

Construction is of anodized aluminum with a cast structural resin outer chassis. Removed from precision optical device. \$229ea. or 2 for \$399.

Exclusive "LAB STYLE" LASERS, 650nm or 635nm, class 3A,

Rugged and dependable. 1 year warranty. Adjustable X & Y beam position.

Aircraft aluminum housing. Internal battery (included) rear push on, push off switch. AR coated end window. 75diam. x 2.75"L



650nm \$69 or 635nm \$99

NEWPORT, MOTORIZED, ROTARY STAGE, mod. 495A, Bidirectional



360° continuous rotation with 0.001° resolution. Integral DC motor and precision encoder. Load independent velocity servo. Can be mounted in any orientation. Load capacity: 55lbs. Size: 4.75"x5"x1.35" With 2" clear aperture.

Newport price....\$2141 Our Price...\$795

75mW ARGON LASER. Brilliant Turquoise beam, Uniphase Model 2213-75 w/2113 power supply.

The 488nm, TEM₀₀ mode is something to see! Power for a "serious" display. Excellent plug and play condition. Power supply (used) can be controlled remotely with optional interfaces.



Standard 220VAC operation. Compact power supply and fan cooled head. Less than one third the price. NEW! Head

Reg. \$6000, Our price..\$1795

Basic remote.....\$175, Remote w/LCD display.....\$595



RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL: unltd4u@iac.net

CIRCLE 283 ON FREE INFORMATION CARD

AMAZING PRODUCTS!



INFORMATION

UNLIMITED DEPT EN 0498
BOX 716 AMHERST, N.H. 03031

VISIT OUR "ACTION" WEB SITE@
<http://www.amazing1.com>

ATTENTION!! RAILGUN EXPERIMENTERS HIGH ENERGY PULSER

RAIL GUN, COIL GUN, EXPLODING WATER, ANTIGRAVITY, MASS
WARPING, LEVITATION, PLASMA PROPULSION, LATTICE SNAPPING, EMP etc

- Lossless Energy Charging
- Programmable Voltage to 2 KV and Energy Control to 3 KJ
- Triggered Spark Switch (IKJ)
- Universal 12 VDC or 115 VAC
- 7.5 X 7.5 X 7" Light weight

HEP3 Plans High Energy Pulser/Ignitor.....\$15.00
HEP3K Kit/ Plans (With 500 Joules Energy Storage).....\$349.50
HEP30 Assembled (With 500 Joules Energy Storage).....\$449.50
All Individual Parts and Subassemblies Available



HOTSHOT

JACOBS LADDER

Observe a pyrotechnical display of "traveling" fiery plasma. Starts off as 1/2" arc and expands to over 3" before evaporating into space. This is an excellent attention getting display as well as a winning science project!! With arc control.

JACK1 Plans.....\$8.00
JACK1K Kit Minus Case.....\$129.50
JACK10 Ready to Use.....\$249.50

12KVG20 Pwr Supply Only.....\$99.50
12KVG20K Kit of Pwr Supply.....\$79.50

3Mi FM VOICE TRANSMITTER

Safety Product Allows Listening to Children or Invalids in Hazardous Areas, Pools, Ponds etc. Great Security Intrusion Alert!! Uses FM Table Top Radio.

FMV1K Kit/Plans.....\$39.50



ATTENTION! ANTI GRAVITY,

We Can Supply Low Cost HIGH VOLTAGE Current Producing Generators from 50 to 500 KV. Contact Factory For Details or Call 603 673 6493

MICRO MINI MITE TESLA COIL

LIGHTS UP A 4 FT FLOURESCENT TUBE WITHOUT CONTACT!! YET ONLY 3" TALL!! Super Magic Trick Low Cost Science Project 12 VDC/115 VAC Operation

MTC1K Kit/Plans.....\$19.50
MTC10 Ready to Use.....\$34.50



BURNING LASER RAY GUN

BLASTS THRU THE HARDEST OF METALS!

All Parts Available

LAGUN2 Plans.....\$20.00



A FUTURISTIC CONCEPT!!

BURNING CO2 BENCH LASER

HOTTER THAN MOST TORCHES!

All Parts Available

LC7 Plans.....\$20.00



PHASOR BLAST WAVE PISTOL

130 db of Directional Sonic Shock Waves Energy Handheld and Battery Operated

PPPJ Plans.....\$8.00
PPPIK Kit/Plans.....\$49.50
PPP10 Ready to Use.....\$79.50



HOVERBOARD PLANS

Kit Soon to be Available

28 Pages of "how to" build a magnetic force field capable of containing a column of ionized air up to several psi! Proven theory may require additional experiment

HOVER Plans.....\$25.00



ELECTRONIC HYPNOSIS AND MIND CONTROL

Generates Highly Effective Audible and Visual Stimuli With Bio-Feedback That Can Induce Hypnotic as Well as ALPHA Relaxed States of the Mind. Place Subjects "Under" Your Control. Enhances Hidden PSYCHIC Ability in Many People!

MIND Plans.....\$15.00
MIND2K Kit and Plans.....\$49.50
MIND20 Assembled.....\$89.50



TELEPHONE TAPING SYSTEM EXTENDED X4 PLAY

Tapes Phone Conversation 20 Megs Input Z1 Check Laws! TAP30X Ready to Use.....\$84.50
BEEP10 Beeper Alert.....\$29.95



TRANSISTORIZED TESLA COIL TURNS A LIGHT BULB INTO A SPECTACULAR PLASMA DISPLAY

Transmits Wireless Energy Noiseless Operation Pyrotechnic Effect 12 VDC/5 Amps or Battery 115 VAC Optional Converter Adjustable Frequency Control For Effect

TCL5 Plans.....\$8.00
TCL5K Kit/Plans.....\$59.50
TCL50 Ready to Use.....\$109.50
12DC/7 12VDC@7Amps.....\$39.50



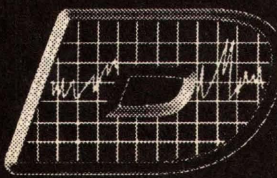
1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST
Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

Quality
Reconditioned

TEST EQUIPMENT

WANTED USED
TEST EQUIPMENT

Visit us at our website
www.danbar.com



DANBAR
SALES COMPANY

Advantest R3271A	\$19,000.00	Hewlett-Packard 8654A	\$800.00
Anritsu MG 3670B	\$17,500.00	Hewlett-Packard 8656B	\$3,995.00
Anritsu MG 3671B	\$19,500.00	Hewlett-Packard 8657A	\$3,900.00
Anritsu MS420K	\$3,500.00	Hewlett-Packard 8662A	\$28,700.00
Avcom PSA35A	\$1,100.00	Hewlett-Packard 8671A	\$4,250.00
Electro-Metrics ESA-1000	\$3,750.00	Hewlett-Packard 8684A	\$2,350.00
Fluke 6011A	\$1,000.00	Hewlett-Packard 8770A	\$6,000.00
Fluke 6060B	\$4,000.00	Marconi TF2015	\$695.00
Fluke 6160A	\$1,350.00	Racal Dana 9084	\$1,500.00
HP 141T/8552B/8553B	\$1,500.00	Racal Dana 9087	\$3,750.00
HP 141T/8552B/8554B	\$2,000.00	Tektronix 2213A	\$600.00
HP 141T/8552B/8555A	\$2,550.00	Tektronix 2220	\$895.00
Hewlett-Packard 3580A	\$900.00	Tektronix 2235	\$950.00
Hewlett-Packard 3585A	\$7,750.00	Tektronix 2246	\$1,400.00
Hewlett-Packard 8562A	\$25,000.00	Tektronix 2430A	\$3,750.00
Hewlett-Packard 8566B	\$39,500.00	Tektronix 2465A	\$3,950.00
Hewlett-Packard 8568A	\$13,000.00	Tektronix 466	\$575.00
Hewlett-Packard 8569B	\$7,900.00	Tektronix 485	\$895.00
Hewlett-Packard 8590B	\$8,000.00	Tektronix TAS 465	\$1,250.00
Hewlett-Packard 8616A	\$850.00	Tektronix TDS 410	\$3,000.00
Hewlett-Packard 8640B	\$1,250.00	Wavetek 3000	\$1,000.00
Hewlett-Packard 8642B	\$29,000.00	Wavetek 3520	\$2,500.00

(602) 483-6202 • (602) 483-6403 Fax

14455 North 79th Street, Unit #C • Scottsdale, Arizona 85260

CIRCLE 235 ON FREE INFORMATION CARD

**Hand-held Oscilloscope
with True RMS DMM
capabilities
for just
\$349.⁹⁵!**

**440 Scope
Plus!**

TPI



**The TPI
440 offers two
instruments in one!**

- View industrial signals such as motor control, UPS, switching power supplies, and PLC controls with 1 MHz bandwidth.
- Capture noise spikes, glitches and those evasive intermittents with 25 Megasamples per second sampling rate.
- Automatically determines correct vertical and horizontal settings to provide optimum waveform viewing.
- Don't miss a beat – the LCD display is continually updated to provide a live presentation of measurement information.
- Easy setup with Help Text. With the push of a button the 440 will help you setup the instrument for a function.
- Full autoranging DMM capabilities with built-in True RMS, 4000 count DMM.

**UL Listed! The TPI 133 is Safe,
Versatile and Affordable!**

- Safe! UL Listed. Meets CE and IEC 1010 Safety Standards.
- Measures AC/DC Volts, AC/DC Amps, Diodes, Resistance and Continuity.
- Easy-to-read, 2000 count LCD, and Data Hold.
- 3 Year Limited Warranty.

TPI 133 just \$49.⁹⁵!



J-TRON INC.
Industrial Electronic Distributors

163 Outwater Lane • Garfield, NJ 07026
Tel: (888) 595-8766 • Fax: (973) 478-8708



One tree can make
3,000,000 matches.



One match can burn
3,000,000 trees.



A Public Service of This Magazine
& The Advertising Council

The World's Largest Source for Home Automation

- The Best & Most Comprehensive Home Automation Catalog in the Industry
- Best Customer Service & Technical Support

FREE

160 page full
color catalog!



Thousands of hard-to-find automation, X-10 and wireless control products. Computer interfaces, software development tools, lighting control, telephone systems, security systems, surveillance cameras, infrared audio/video control, home theater, touchscreen control, HVAC, pet care automation, wiring supplies, books and videos and much more!

World's Largest Selection!

Lowest Prices Guaranteed!

HOME AUTOMATION SYSTEMS, INC.

Questions: 949-221-9200 Fax: 949-221-9240

e-mail: catalog@smarthome.com

www.smarthome.com

Call for a **FREE** Catalog! 800-762-7486

800-SMART-HOME

Dealers/Resellers ask about our
SmartHome PRO Dealer Program 800-949-6255

FCC License Preparation

Electronics Tech., Avionics, Marine & Radar
HOMESTUDY—Fast, Easy & Inexpensive
Manuals, Audio, Video, PC disks, latest Q&As
Free 1-800-800-7555 "Guaranteed Pass"
See at <http://www.worldaccessnet.com>
BusinessShowcase/wpt. 4701 NE 47th St.
Vancouver, WA 98661 – WPT Publications

VIDEO SYNC GENERATOR



Restores Horizontal
and Vertical
Sync Lines from
Distorted Video



Lost Sync



Restored Sync
with VSG

For Free Information Package and Pricing



Call (219) 233-3053
www.south-bend.net/rcd



R.C. Distributing, P.O. Box 552, South Bend, IN 46624

Call Today And
SAVE!

**Unbeatable
PRICES!**

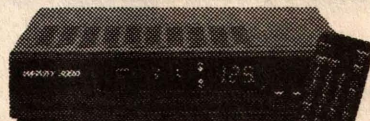
CABLE TV

**DESCRAMBLERS
CONVERTERS • FILTERS
VIDEO STABILIZERS**

**FREE
FREE
FREE**

- 30 Day Trial
- Product Catalog
- 1 Year Warranty

100% MONEY BACK GUARANTEE



Let us point you in
the right direction ...

Arrow
Technologies
Omaha, Nebraska

TOLL FREE
888-554-ARROW
888-554-2776



Free Catalog

If you are not getting this catalog you are missing out on some of the best deals in electronics today! We have thousands of items ranging from unique, hard-to-find parts to standard production components. Call, write, or fax today to start your free subscription to the most unique catalog in the industry, filled with super values on surplus electronic and hobbyist type items. If you have a friend who would like to receive our catalog, send us their name and address and we will gladly forward them a complementary 100 page catalog.

Why pay more? Call today.



340 East First Street Fax Order Line
Dayton, Ohio 45402 1-800-344-6324

**Order Toll-Free
1-800-344-4465**

CIRCLE 251 ON FREE INFORMATION CARD

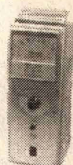


100 W AUDIO AMP

GROMMES-PRECISION ST100E AUDIO AMPLIFIER, solid state 100 watt public address amp; response 35 to 20000 Hz 4 ohm output, 0.3% distortion. Volume controls for MIC-1 & -2, AUX input, MUSIC and MASTER plus BASS and TREBLE controls. Also slide switches Loudness bass boost and Lo Filter plus Peak Power/Over-load indicator. Back panel outputs for 4 to 8 ohm and 25 or 70 V speakers, Booster Amp, Mute, 600 ohm telephone line page, two Lo or Hi Z mic select, two XLR 3-pin male mic connections and AC accessory outlet. 4.3x15x12.8, 25 lbs sh. NEW, \$249.50

1950's CAR TESTER

HEYER MODEL 337 TACH / VOLTMETER with 4.5" chrome-rimmed meter. ranges 0-1000 & 0-5000 RPM and +/- 0-18 VDC. Amplifier button plus socket for timing light. With tubes 0A2 & 2D21; 6 or 12 VDC use. Nice addition to a car collector's display or for experiment! 13x5x5, 9 lbs. UNUSED, not tested, \$24.95



1 - 1400 MHz Sweeper



WAVETEK 2001A SWEEP GENERATOR, covers 1 to 1400 MHz sweep and CW in bands 1-500, 450-950, and 950-1400 MHz. Sweep width 50 KHz to 500 MHz. Sweep time: 100 to 0.01 S in 4 decade steps. Markers at 0.2, 1.5 and 20 MHz harmonics and single frequencies 63 MHz, +/-0.35 and +/-0.9 MHz. Marker width 15-400 KHz in 4 steps. RF output continuously adjustable +9 to -81 dBm into 50 ohms. Requires 115/230 VAC 50-60 Hz; 5.3x 11x14.2, 25 lbs sh. USED-reparable w/book, \$395.00

30 FT MAST KIT

AB-1244/GRC MAST KIT, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit includes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus a 2.5 pound sledge hammer. Part of OE-254/GRC antenna set; 30 lbs. NEW, \$139.50

Prices F.O.B. Lima, Ohio. VISA, MASTERCARD accepted. Allow for shipping charges. Write for latest Catalog. Address Dept. ES + Phone 419/227-6573 + FAX 419/227-1313 E-mail: fairradio@wcoil.com Home: <http://www2.wcoil.com/~fairradio>

FAIR RADIO SALES CO.

1016 E. Eureka + Box 1105 + Lima, Ohio 45802

LASERS

AT GREAT PRICES

Complete Ruby Laser Assembly less than \$300
He-Ne Lasers, complete, for less than \$50
American 60X Argon Lasers from \$595
Laser Diode Modules from under \$40
X-Y Scanners from \$79

FREE CATALOG

- Helium-Neon
- Argon Lasers
- Diode Lasers
- Holography
- Books
- Ruby Lasers
- Scanners
- Lightshow Equipment
- Pointers
- Optics

Email: mlp@nlenx.com <http://www.midwest-laser.com>



Midwest Laser Products

P.O. Box 262, Frankfort, IL 60423
Phone: (815) 464-0085 FAX: (815) 464-0767

30 Day Satisfaction Guarantee.
VISA / MC Accepted

BOSSMAN ELECTRONICS

PH:011 61 2 86843662. FAX:011 61 2 86843661. All prices US\$. Typical insured Air Mail: \$10-\$20. PAYMENT BY MAJOR CREDIT CARDS ONLY.

CCD CAMERA \$85 Low light high resolution CCD camera, two versions, NTSC (US) or PAL (European) compatible. FREE VHF VIDEO MINI MODULATOR With every camera. (Pin2). (US chn 34.4) This unit allows you to use your TV's antenna input. \$59



12VDC - 240AC INVERTER Features include modified square wave output. Auto start with load sensing, req. minimal heatsinking required. 200 - 600VA. dependant on trans. former size. Basic kit includes PCB & all on-board components + 4 60A MOSFETS. Req. 110V to 8-0-8 V. transformer \$23

HIGH POWER 801R ILLUMINATOR With strong universal swivel mount and housing. \$36 For other sizes check our Web Site



LEDs, FLASHING LEDs & PHOTO TRANSISTORS (NOTE: When buying LEDs that most STANDARD LEDs are only 1mC or less!!)

5mm 3000 mC - YELLOW-10 for \$4... 3600 mC - RED-10 for \$4... Photo Transistor CLEAR-10 for \$4... 5mm FLASHING 3000 mC - YELLOW-10 for \$7... 300 mC - RED-10 for \$7

BACK IN STOCK High quality U.S. made IR Night Vision Tubes IC 18 (RCA-ITT) tubes tested and in excellent condition Tube + eye-piece + power supply kit \$55 Some object lenses available. \$55



20-30 SECOND DIGITAL SOUND RECORDER KIT. This could be used as an answering machine at your front door or as a personal reminder device. Good quality sound. Uses LSI chip with memory etc. built in. Kit includes PCB all on-board components, microphone, switches & speaker. \$14

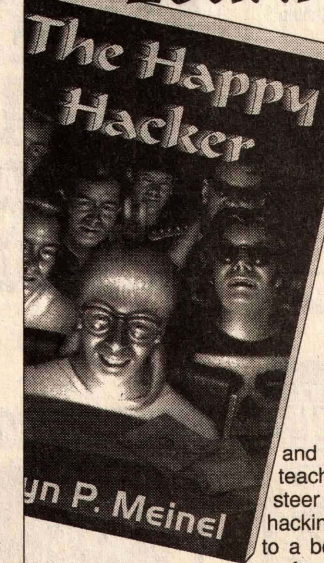
PIC MICRO PROGRAMMER JUST \$20 Learn program your own 16F83 / 16F84 / 16C84 micro-controllers with this kit the simple way. Kit inc. program examples and notes PCBs, all on-board components, D025 connector and a PIC chip ready to program. Software available on our web page. \$25

MORE KITS- DUAL STEPPER MOTOR DRIVER KIT with two used motors & software: \$40... GIGER COUNTER KIT: \$30... \$39... AUDIO LASER SCANNER KIT w/d patterns: \$35... Check out our web site for more kits and specials.....

STOP PRESS..... 650nm-5mw LASER DIODE POINTERS \$14 650nm-5mw LASER DIODE MODULES \$19

www.world.net/~bossman

Learn to Hack!



Finally, here is a no-nonsense technical book on computer hacking! In it you will learn how to hack computers you have physical access to and how to hack on the Internet. With this book, you will learn about:

- Finding computers to hack
- Breaking into computers
- Hacking with Finger
- Port surfing
- Mapping the internet
- Forging E-mail
- Fighting spam
- E-mail bombs
- Hacker wars

and more! But this book will also teach you how to hack safely. It will steer you clear of the law, so that your hacking career won't lead to prison, but to a better job! *By far, the best book on hacking available today!*

266 PAGE PAPERBACK, \$29.95 SHIPPING \$3

Call (800)719-4957 now!

to order (Visa/MC/COD) or call or write for FREE CATALOG of hard-to-get information about computer viruses, computer hacking, security and cryptography!!

Check our web site: www.logoplex.com/resources/ameagle
American Eagle Publications, Inc.
P. O. Box 1507, Dept E.
Show Low, AZ 85902

CIRCLE 270 ON FREE INFORMATION CARD

Whaddya Say To
A Guy Who's Had
The Same Job
For 50 Years,
Has Never Called
In Sick Or
Showed Up Late,
Never Taken A
Vacation Or A
Holiday, Never
Asked For A
Raise Or Griped
About His Bonus
And, Believe It Or
Not, Has No
Plans For
Retirement?



Thanks.

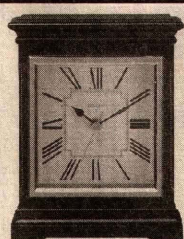
Remember - only you can prevent forest fires.

Source Code: 901EN

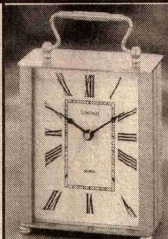
Sale Ends: 1/15/99

www.spysite.com

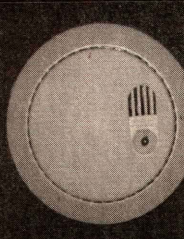
COVERT SURVEILLANCE: Protect Your Assets



MC-985 \$350



CL-985 \$350



SD-985 \$295



VL-985 \$350

EXIT SIGN
CAMERA
EX-985 \$295

EMERGENCY
LIGHT
CAMERA
EL-985 \$325

All "985" Series Color Cameras Feature:

- Sensor: 1/3" Sharp® Color CCD
- Resolution: Over 380 TV lines
- Sensitivity: Super Low, 2 Lux
- Built-In Backlight Compensation
- Lens: 3.7 mm Pinhole
- Viewing Angle: 92 FOV
- Video Output: Female RCA
- Power: 5V DC (included)

CLOSEOUT

Color Camera Kit:

- 1/2" Sony Color CCD
- 400 TV line Res.
- 2 lux Sensitivity
- Backlight Compensation
- 4 mm Standard Lens
- Wall Mounting Kit
- 5V Power Transformer

SONY-1002 \$175

Counter Surveillance: Protect Your Privacy

Protect Yourself From:

- Telephone Taps
- Room Transmitters
- Body Wires



Built-In White Noise Generator

AI-5500 \$380

Detects Concealed:

- Tape Recorders
- Video Cameras
- Body Transmitters
- Room Transmitters



LED and Vibration Alert

TRVD-900 \$495

Your Payment Options: Credit Card, Cashier's Check, or Money Order

AMERICAN INNOVATIONS, Inc.

119 ROCKLAND CENTER ~ Suite 315 NANUET, NY 10954
Voice: (1)914-735-6127 Fax: (1)914-735-3560

CIRCLE 218 ON FREE INFORMATION CARD

Weeder Technologies



FREE CATALOG!



Pro-Kit

PO Box 2426, Ft. Walton Beach, FL 32549

www.weedtech.com

Voice/Fax 850-863-5723

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

Analog Input - 8 input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$49**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive and transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ascii character string. Example: "12/31 08:45 850-863-5723 Weeder, Terry <CR>". Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones used to dial telephones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation or Digital I/O kits using a remote telephone. **\$34**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have "not" been entered.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$46**

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **\$49**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in a non-volatile memory which can be scrolled through. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

Interactive catalog: www.tekview.com

TV

cable

CONVERTERS & EQUIPMENT

Clearview Group



* 30 days money back guarantee
* 1 yr warranty
* Quantity Discounts
* Dealers Welcome!

VISA MC AMEX C.O.D.

(800)739-2253

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

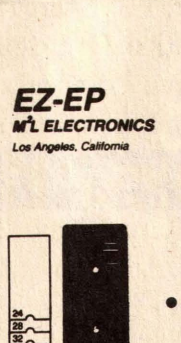
Fast - Programs 27C010 in 23 seconds
Portable - Connects to PC Parallel Port
Versatile - Programs 2716-080 plus EE and Flash (28F,29C) to 32 pins
Inexpensive - Best for less than \$200

- Correct implementation of manufacturer algorithms for fast, reliable programming.
- Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web page.
- Full over current detection on all device power supplies protects against bad chips and reverse insertion.
- Broad support for additional devices using adapters listed below.

Available Adapters	
EP-PIC (16C5x, 61, 62x, 71, 84)	\$49.95
EP-PIC64 (62-5, 72-4)	\$39.95
EP-PIC12 (12C50x)	\$39.95
EP-PIC17 (17C4x)	\$49.95
EP-51 (8751, C51)	\$39.95
EP-11E (68HC11 E/A)	\$59.95
EP-11D (68HC11D3)	\$39.95
EP-16 (16bit 40pin EPROMS)	\$49.95
EP-Z8 (Z86E02, 3, 4, 6, 7, 8)	\$39.95
EP-SEE2 (93x, 24x, 25x, 85x)	\$39.95
EP-750 (87C750, 1, 2)	\$59.95
EP-PEEL (ICT22v10, 18v8)	\$59.95
EP-1051 (89C1051, 2051)	\$39.95
EP-PLCC (PLCC EPROMs)	\$49.95
EP-SOIC (SOIC EPROMs)	\$49.95

Many Other Adapters Available

M²L Electronics
970/259-0555 Fax: 970/259-0777
361 S Camino Del Rio Suite #119; Durango, CO 81301; CO orders add 7% sales tax.
<http://www.m2l.com>

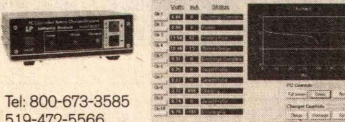


EZ-EP
M²L ELECTRONICS
Los Angeles, California

Battery Analyzer

PC-Controlled Battery Analyzer
Cycle, Charge & Test with your PC
Print reports, plot graphs, expandable

\$398



Tel: 800-673-3585
519-472-5566
Fax: 519-472-1702

Download Demo: <http://home.rogerswave.ca/lamantia>
lamantia@compuserve.com

LaMantia Products Ltd.

www.cable4less.com

Cable TV

Z Products

Best Service!
Best Prices!
Dealers Wanted!
30 days money back
1 year warranty

1- 800 - 660- 4180

Visa MC Amex Discover C.O.D.

MEMBRANE SWITCHES



Stock Layouts!

Eliminates tooling cost...

****From 2 to 128 keys****

Industrial/Commercial/Prototyping

Popular types are available as complete kits, with bezel, connector & overlay!

4 key DSK-4 kit **\$9.60**
12 key DSK-12 kit **\$13.87**
many more layouts...

Optional Stainless Steel "Clickdomes"

Sil-Walker

(805) 491-0654
FAX (805) 491-2212
P.O. Box 3220
Camarillo, CA 93011-3220
silwkr@vcnet.com
www.vcnet.com/silwkr/

MASTERCARD/VISA

Great consumer information is a shoe-in with our free Catalog. Call toll-free 1 (888) 8-PUEBLO or go to www.pueblo.gsa.gov.

Identify and Control with Radio Frequency Identification

Transponders, Antennas, Reader/Decoders

for access control, animal feeding, pet id, race timing, inventory control, eas, pallet control, garment management, plant routing, equipment locator, personnel, ...

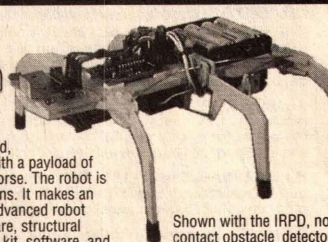
Since 1991

INTERSOFT

1840 Lockmill Rd, Estill Springs TN 37330, USA
Phone 931-967-8643 Fax 931-967-5069
www.cafes.net/intersoft

Development kit
US\$ 139.00

Hexapod Walker Kit \$150.00 Plus S&H



lynxmotion

You can build this Hexapod Robot
This easy to build robot really walks using an alternating tripod gait. It can walk forward, reverse, and turn on a dime, left or right. With a payload of more than 12 oz., this robot is a real workhorse. The robot is programmed using simple BASIC instructions. It makes an excellent foundation for many simple and advanced robot experiments. The kit includes all the hardware, structural components, Hitec servos, First Step Micro kit, software, and an illustrated assembly manual. The Lynxmotion Hexapod Walker is a lot of fun to build and even more fun to operate.

Shown with the IRPD, no contact obstacle detector.

We have many more cool robots, check out our web page or ask for our free catalog!

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403
www.lynxmotion.com

Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

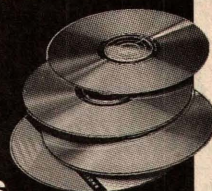
MasterCard VISA

A Trained Computer Repairman Charges \$100 An Hour and More... You Can Get That Training!

Foley-Belsaw's Totally New
Computer Repair Course
gives you the skills to
start earning top pay
FAST!!!!!!

You get these Foley-Belsaw
Exclusives! At no extra cost!

- A+ Certification Test Preparation Tutor™
- Foley-Belsaw CD-ROM Learning Assistant™
- Business Start-up Resource



SPECIAL BONUS

Inquire now and your course will come with a complete video archive library of early printer and computer repair techniques... at no additional cost.



No Experience Necessary!

Get "hands-on" training in the exciting field of computer repair.

Train At Home!

There's not a more complete—or affordable—PC Repair course that will have you trained and job ready in such a short time.

Take the first step to top pay.
Call for a **FREE Opportunity Kit** today!
1-800-487-2100

Fully illustrated, easy to understand course gives you everything you need to succeed.

The key to your success lies in providing a service that is in great demand. Even if you have no experience, you can become an expert in a few short months. Foley-Belsaw's computer repair course is broken into small, easy to manage lessons. Each lesson is designed with your success in mind. After you complete the course, you'll have the expert knowledge to earn up to \$100 an hour, or more!

Latest technologies and insider knowledge available only to Foley-Belsaw students!

Get the "hands-on" experience you need in Computer Repair. Foley-Belsaw's CD-Rom Learning Assistant™ guides you through each lesson and is always right at your fingertips. The Test Preparation Tutor™ makes preparing for your A+ Certification as easy as turning on your computer. Foley-Belsaw's inside knowledge gives you the practical experience to become a computer repair professional. Get started today!



World leader in training since 1926, provides at-home, "hands-on" training in high-demand fields.

or complete this coupon and mail to Foley-Belsaw Institute, 6301 Equitable Road, Kansas City, MO 64120-1395

☐ **Yes!** Send me one of the following **Free Opportunity Kits:**

- ☐ Computer Repair, Maintenance, Upgrade, Dept. 64775
- ☐ Personal Computer Specialist, Dept. 38412
- ☐ Professional Computer Programming, Dept. 35591
- ☐ Professional Saw and Tool Sharpening, Dept. 21978
- ☐ VCR/DVD Service and Repair Dept. 62873
- ☐ Small Engine Service and Repair, Dept. 53046
- ☐ TV/Satellite Dish Service and Repair, Dept. 31644
- ☐ Professional Gunsmithing, Dept. 92680
- ☐ Home Inspection, Dept. 76095
- ☐ Networking Specialist, Dept. 39399
- ☐ Locksmithing, Dept. 13172
- ☐ Woodworking, Dept. 43910
- ☐ Upholstery, Dept. 81582
- ☐ Vinyl Repair, Dept. 71513
- ☐ Electrician, 95452

**Satisfaction
Guaranteed**
**Foley-Belsaw gives you
a Free 30-Day Trial.**
Be careful!
Most schools charge \$150.00
for this privilege.

Name _____

Street _____

City _____

State _____

Zip _____

Phone () _____

386 MINI-PC \$83

1K PRICE
EVAL \$295
8088 \$27



includes:

- 5 Serial, 3 Parallel (32bit max)
- Up to 8 meg ROM (27C080)
- 32k RAM exp. to 64Mbyte
- Battery backed RT Clock
- LCD and Keyboard ports
- IRQ x15, DMA x2, TIMER x4
- On-board LED display
- Industry Standard PC Bus

Perfect when a full-size PC is too large, expensive, or power hungry. A fully functional single board computer, needs only program and power source. Runs DOS / WINDOWS. Use Turbo C, BASIC, MASM. All utilities to do this included.

A to D D to A CONVERTERS

For PC or SBC
8,12,16 bit resolution
up to 24 channels
starting at \$21 OEM (1k)
eval kit \$75

\$95 UNIVERSAL PROGRAMMER

FLASH, EEPROM, NVRAM, EPROM up to 8 meg (27C64-080). Adapters for micros, PLCC, etc. Parallel port version for notebook. FAST AND EASY TO USE.



LOW COST... LOW POWER...

LOW RISC!

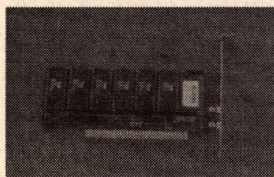
QTY 1K PRICE
\$1.99
EVAL KIT 7.00

LOWER COST, FASTER, EASIER TO PROGRAM SINGLE CHIP COMPUTER

COMPARE:	16C54	MV1200
OEM (1K) PRICE	\$2.57	\$1.99
RS232 PROGRAM DOWNLOAD	NO	YES
SINGLE CHIP OPERATION	NO	YES
BUILT-IN BASIC	NO	YES
EEPROM DATA MEMORY	NONE	64
PROGRAM MEMORY	768 OTP	1K FLASH
MATH REGISTERS	1	32
MAX INSTRUCTIONS / SEC	5M	20M
MAX COUNTER BITS	16	18
INPUT / OUTPUT BITS	12	15
A TO D COMPARATOR	NO	YES
HARDWARE INTERRUPTS	NONE	3
- LONG WORD INSTRUCTION - FRIENDLY SYMMETRIC ARCHITECTURE -		

PINOUT:

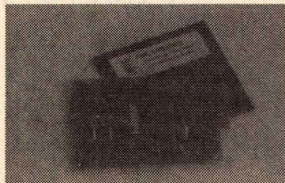
RESET	1	20	VCC
PD0	2	19	PB7
PD1	3	18	PB6
XOUT	4	17	PB5
XIN	5	16	PB4
PD2/INT	6	15	PB3
PD3	7	14	PB2
PD4/TMR	8	13	PB1/AD1
PD5	9	12	PB0/AD0
GND	10	11	PD6



PC SOLID STATE DISK
\$21 OEM (1k) eval kit 75.00
FLASH / RAM / EPROM
256K-16M PCMCIA/DIPS

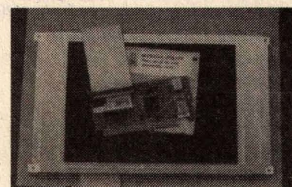
No More Hangups... PC WATCHDOG!

Reboots PC OEM \$21 EVAL \$75



VGA LCD

640x480 controller for PC or SBC
\$27 oem \$95 eval
combo LCD/CRT version available



visit our web site: www.mvsweb.com

MVS BOX 850
MERRIMACK, NH 03054
(508) 792-9507

MVS

5yr Limited Warranty
Free Shipping
Hrs: Mon-Fri 10-6 EST

EPROM+

The Professionals Choice!

A rugged device programming system for bench and field

Uses parallel printer port!

Supports all standard parts!

Excellent, easy-to-use software!



FIRST GENERATION EPROMS 2708, TMS2716*, 25XX

SECOND GENERATION EPROMS (24, 28, 32 PIN) 2716 - 27C080 (8 MEG)

16 BIT EPROMS* (40, 42 PIN) 27C1024 - 27C160 (16 MEG)

FLASH EPROMS (28, 32 PIN) 28F, 29C, 29EE, 29F FAMILIES PLUS BOOT BLOCK DEVICES

EEPROMS/NVRAMS (24, 28, 32 PIN) 28C04 - 28C010, X2210/12, ER5901, PLUS DALLAS 12XX

SERIAL EPROMS* (8, 14 PIN) 17XX, 24XX, 25XX, 35XXX, 59XX, 85XX, 93XX, 95XX+ER1400

BIPOLAR PROMS* (16 - 24 PIN) 74SXXX AND 82SXXX FAMILIES

MICROCONTROLLERS* (ALL FAMILIES) 874X, 875X, 87C5XX, 87C75X, 89C5X, 89CX051

89SXXX, 90SXXX, 68705, 68711, PIC12CXXX - 16CXXX, 17C4X PLUS FLASH AND 14000

* READ, PROGRAM, COPY, COMPARE, FILE LOAD/SAVE (PLUS MUCH MORE!)

* FULL SCREEN EDITOR W/25 CMDS + BYTE/WORD MODES

* RUNS UNDER DOS, WIN3.1/95/98 AT ALL CPU SPEEDS

* SUPPORTS INTEL HEX, S-RECORD AND BINARY FILES

* MADE IN USA • 30 DAY MONEY BACK GUARANTEE

\$289

SYSTEM INCLUDES: PROGRAMMING UNIT, PRINTER \$5.00 SHIPPING • \$5.00 C.O.D.
PORT CABLE, POWER PACK, SOFTWARE & MANUAL VISA+MASTERCARD+AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OH 45150
(513) 831-9708 FAX (513) 831-7562 website - www.arlabs.com

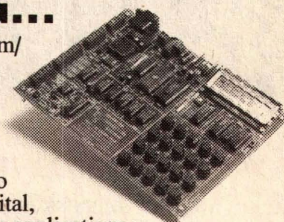
Help protect our nation's soil and water.
Call for your free action packet.

1-800-THE-SOIL
WE OWE IT TO OUR CHILDREN

United States Department of Agriculture
Soil Conservation Service

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

...with the AES learning system/
embedded control system.
Extensive manuals guide you
through your development
project. All programming and
hardware details explained.
Complete schematics. Learn to
program the LCD, keypad digital,
analog, and serial I/O. for your applications.



**THREE MODELS AVAILABLE. Choose from an
Intel 8051, Intel 8088, or Motorola 68HC11
based system. All models come with:**

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279.
Money Back Guarantee

Call for Free Info Pack, or see
WEB at <http://www.aesmicro.com>
714-550-8094, FAX 714-550-9941

AES
Advanced Educational Systems

Call 1-800-730-3232

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

Electronic CAD for Windows

Professional Windows EDA tools at an affordable price with powerful features to make designing faster. WinBoard PCB layout delivers sophisticated interactive routing for complex designs, plus it has the tools needed for high-speed circuits, analog, RF and SMT designs.

WinDraft® Schematics

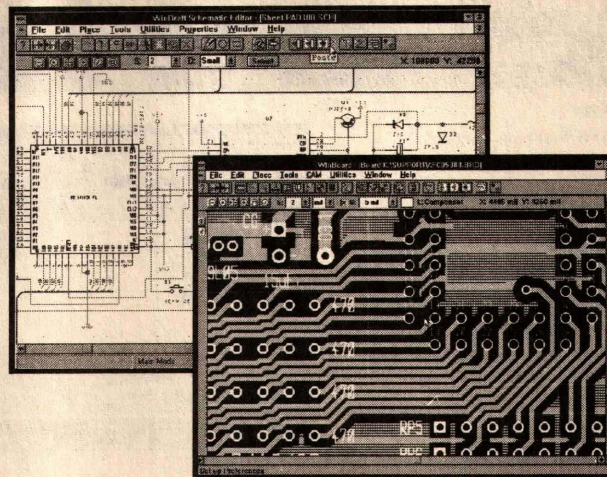
- ◆ Use True-Type fonts. Quickly copy and paste into other applications.
- ◆ Supports hierarchical designs, electrical rules checking, Annotation & Bill of Materials.
- ◆ Thousands of library parts and symbol editor included.

WinBoard™ PCB layout

- ◆ Supports 16 layers, multiple copper pours, and advanced features for RF designs.
- ◆ SMD & through hole library with on-line graphical editor.
- ◆ CAM outputs include BOM, in-circuit test, NC Drill, Gerber, Pick & Place, & Advanced Design Rule Checking (DRC).

With our unique **pin capacity** versions you only pay for what you need. You choose the base configuration to suit your needs today, and expand that configuration to handle increased pin capacity as your design requirements change.

WinDraft 2.0 Available Now



\$ 250 WinDraft or WinBoard - P650
\$ 495 WinDraft or WinBoard - unlimited

\$ 895 WinBoard P650 with CCT Spectra® autorouter.

Thousands of satisfied customers are using this new generation of powerful and affordable Windows EDA tools from Ivex. Your satisfaction is guaranteed!

World Wide Web: <http://www.ivex.com>

Information and free evaluation version is available on the Ivex WW Web, FTP and BBS.

Tel: (503) 531-3555
Fax: (503) 629-4907
BBS: (503) 645-0576



Ivex Design International. 15232 NW Greenbrier Parkway. Beaverton, Oregon 97006. USA.

ADV2_1

CIRCLE 319 ON FREE INFORMATION CARD



To learn more about life-saving techniques, call your Red Cross.



PicC C Compiler \$59

for Microchip's PIC microcontrollers
Supports PIC16C55x, 16C6x, 16C8x, 16C92x PIC families

SnXC C Compiler \$59

Supports **Scenix** sx18ac and sx28ac microcontrollers
Both compilers based on ANSI C standard. Arrays, unions, structures, pointers, strings, function calls, if, for, switch, while, interrupt vectors, in-line assembler code, 8 & 16 bit variables, etc. Outputs Intel Hex format and assembly code. Code optimizer included. Excellent development tools!

DebugIDE Debugger \$79

C source level debugger for PicC and SnXC compilers. Integrated Development Environment. Step, Run, Stop, Reset. Variable monitoring and modification. Oscillator/cable kit (\$39)

732-873-1519 fax: 732-873-1582 e: grichrc@aol.com

Grich RC Inc. 120 Cedar Grove Ln, Ste 340, Somerset NJ USA 08873

URL: <http://members.aol.com/picccompiler>

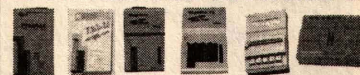
Filter Wiz v2.0

ACTIVE FILTER design software for Windows. Provides mastery of lowpass, highpass, bandpass and bandstop filters. Enhance critical signal components while controlling noise and other interference. Meets the needs of both novice and professional designer. Standard (LE) version \$89, PRO version \$199.

Download: <http://www.schematica.com>
sales@schematica.com FAX: 250-642-2644

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAM'S DATA I/O ICE TECHNOLOGY HILO SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SIP TESTER EMUPA

CALL ADVANTECH LABTOOL	599 EETOOLS SIMMAX
629 ICE TECH MICROLV	795 CHROMA SIMM/SIP
650 EETOOLS ALLMAX +	359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX	279 MOD-MCT-EMUP/R
509 EETOOLS MEGAMAX4	49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II	69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P	99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L	199 EPROM 16G TO 1MEG
165 XELTEK ROMMASTER II	89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA	129 EPROM 4G TO 8MEG
739 STAG ORBIT-32	250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 916-393-1655 Fax 916-393-4949 BBS 983-1234

Web www.generaldevice.com E-Mail icdevice@best.com

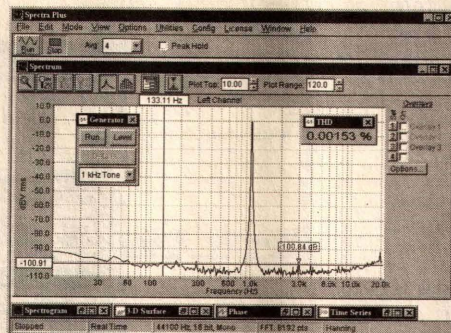
January 1999, Electronics Now

91

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- Distortion measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications

- Distortion Analysis
- Frequency Response Testing
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor

PHS Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.

Sales: (360) 697-3472

Priced from \$495

(U.S. sales only – not for export/resale)

DOWNLOAD FREE 30 DAY TRIAL!

www.spectraplus.com

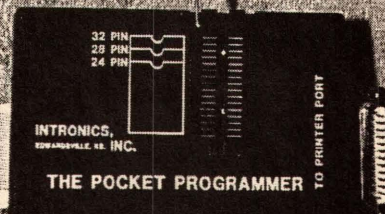


Spectra Plus
FFT Spectral Analysis System

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

The Pocket Programmer Only \$129.95



The portable programmer that uses the printer port of your PC instead of an internal card. Easy to use software that programs Eprom, EEprom, Flash & Dallas Ram. 27(C) / 28(C) / 28F / 29F / 29C & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, PLCC, 5-Gang, 874X, 875X MCU's, 40-Pin X 16 & Serial Eprom's, 82/74 Prom's and Eprom Emulator to 32K X 8.

Same Name, Address & Phone # for 16 Years... Isn't it Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.
Edwardsville, KS 66113 Add \$5.00 COD
Tel. (913) 422-2094 Add \$4.00 Shipping
Fax (913) 441-1623 Visa / Master Charge

CAD FILES TO CASH PILES

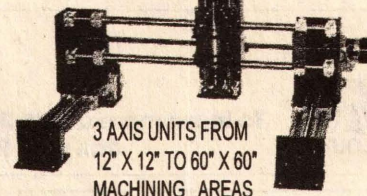


IMAGINE THE POSSIBILITIES!
ROUTE, MILL, DRILL, CARVE,
ENGRAVE, PAINT, ETC.
IN WOOD, PLASTIC, VINYL,
PC BOARD, & LIGHT METALS.

THE ROBOPRO X50
CNC ROBOTIC MACHINING SYSTEM
YOUR WISH IS ITS COMMAND!



STARTING AT
\$895.00



3 AXIS UNITS FROM
12" X 12" TO 60" X 60"
MACHINING AREAS

Visit us at
www.uscyberlab.com

U. S. CYBERLAB, INC., 14786 SLATE GAP RD., WEST FORK, AR 72774
VOICE (501) 839-8293 / 24 HR. FAX BACK (501) 839-8293

TRAVEL LIGHT.



American Heart Association



EXERCISE.

MONDO • TRONICS

ROBOT STORE

* KITS *

Your

* BOOKS *

Mailorder

* PARTS *

Source

* VIDEOS *

For

* MODELS *

Robots!

* MORE! *

(REQUEST OUR FREE CATALOG)

www.robotstore.com

800-374-5764

Or write to us:

4286 Redwood Hwy #226-137
San Rafael CA 94903

Phone 415-491-4600 • Fax 415-491-4696

Email info@mondo.com

3 Axis Motion Control System

Complete, ready to run

\$ 255.50 + 12.00 S/H

Build or adapt CNC mills, CNC routers, Robots, Etc.
Includes: 3 Stepping motors (70 oz in 200 steps/rev).
External board (connects to parallel port of a PC). Power
supply. Cables, Manual and the MAXNC drive software,
with linear, circular and helical interpolation, acceleration
deceleration, full contouring, 'G' code programming,
screen plot, code generation from CAD (CAM), and more.

For more information,
phone or write to:

MAXNC

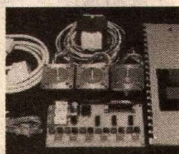
6730 West Chicago

Suites 2 & 3

Chandler, AZ 85226

Ph (602) 940-9414

Fax (602) 940-2384



New!

Low Cost, Precision-Made
PC BOARDS

From Your Gerber/NC Drill Files



www.pcbmilling.com FAX: (703) 818-0071

BUGGED??

EAVESDROPPING is unbelievably widespread! Electronic
Devices with amazing capabilities can be monitoring your
telephone and room conversations RIGHT NOW! Are you
sure you're safe? **FREE CATALOG** tells you fast! Includes
Free Bonus details on fantastic opportunities now open in
Counter-Surveillance field. Exciting, immensely interesting
and EXTREMELY profitable (up to \$250 hr) full/part-time
income. Call Now! **1-800-732-5000**

CABLE TV DESCRAMBLERS

***GUARANTEED
LOWEST PRICES***
***DESCRAMBLERS
FOR ALL SYSTEMS***

FREE SHIPPING

**CRAZY LIZ'S ELECTRONIC
WAREHOUSE**

CALL TODAY!

1-800-391-7803

EQUIPMENT IS NEW & GUARANTEED

!!!BROADCAST EQUIPMENT!!!

We manufacture & carry Stereo FM Transmitters,
RF Amplifiers, Low Pass Filters, Antennas, DJ Mixing
Boards & Consoles, Mics, Compressor/Limiters, Digital
Reverbs, Automation Software, RF Test Equipment, RF Parts
including BGY133's, and much more! Call For Free Catalog.

Progressive Concepts
BOX 586 STREAMWOOD, IL 60107
(630) 736-9822 FAX: (630) 736-0353

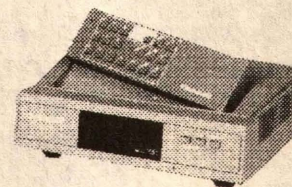


ATTENTION DEALERS: WHOLESALE ONLY!



**BEST PRICES!
FAST SERVICE
SAME DAY SHIPPING**

EXCLUSIVE:



2 PIECE SETUPS: \$85⁰⁰

10 lot • 1 Year Warranty

**Latest Technology • Universal Combo's - Ask For Details
CALL US LAST! LOWEST PRICES GUARANTEED!**

**TOLL FREE:
800-375-3682**



**FAX:
516-246-5634**

Direct from Manufacturer
We will beat any competitor's price

World's Smallest Wireless Video Camera!

- Transmits video up to 1000 ft.
- Runs on 1 qv. battery for 12 hrs.
- Can be built into just about anything (beeper, clock, etc.)

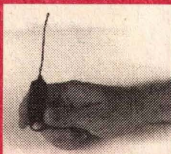
We also carry:

- Color micro video cameras
- B&W micro video cameras
- Hidden cameras
- Custom video systems
- Countersurveillance & More

World's smallest
plug & play system
about 1" x 1"

Looking
for
Distributors

Call for a free catalog (305) 667-4545
SECURETEK Fax (305) 667-1744
7175 SW 47 St. #205 • Miami, FL 33155



1 MB cache, AMD 300

System featuring:

Enlight Mini Tower, VIA chipset, 100-MHz operation, 2 USB ports, 64 MB PC-100 compatible memory, 6.4 GB IBM UDMA33 hard drive, 32X CD-Rom with audio button, 4 MB AGP video card, S3 chipset, 1.44 floppy, V.90/X2 PCI fax/modem, 3D sound card, full-size speaker set, 15" digital monitor,

Windows 98 on CD **\$993**

tech-specialities, Inc.

(800)864-5391, fax: (713)307-0314

email: sales@ts.nu, web: www.ts.nu

Detailed Quote on other configurations (PII 300/450, single/dual CPU or low cost, 233 MHz, 32 MB - \$570 w. monitor) by email, fax or phone. Ask for our **Free Shipping** option! Illustrated 32-page **Catalog** with latest parts, many more system options, benchmark comparisons and technical tips free!

ADAPT-11 68HC11 Modules for Solderless Breadboards

- miniature 2.0" by 2.8" module
- plugs vertically into solderless breadboard for easy development
- BOOT/RUN switch for easy programming via PC serial port
- all I/O lines on dual row connector

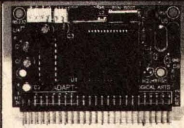
Complete modular prototyping system!
Expansion accessories available!

For just US\$74.95, our Starter Package (AD1ISP) provides everything you need to get going fast! Now you can harness the power of the popular 68HC11 in your projects! Includes ADAPT-11 with 68HC811E2, providing 2K EEPROM (re-programmable), 8 channel 8-bit Analog-to-Digital Converter (ADC), hardware timers, counters, interrupts, Serial Peripheral Interface (SPI), Serial Communications Interface (SCI), & more! On-board RS-232 interface (cable included), 5-volt regulator, 8MHz crystal, reset circuit, and convenient program/run switch. Comes with non-commercial versions of "HC11 Assembler, BASIC, & C, as well as handy utilities & example code. Includes Motorola 68HC11 Pocket Programming Reference Guide and manual with schematic. All you need is a PC to write & program your software, a DC power supply, and a solderless breadboard (or protoboard) to build your application circuits on (or use our modular accessories).

Visa • MasterCard • AmericanExpress • Discover

TECHNOLOGICAL ARTS

309 Aragona Blvd., Suite 102, Box 418, Va. Beach, VA 23462
1644 Bayview Avenue, Box 1704, Toronto, ON M4G 3C2
voice/fax: (416) 963-8996 www.interlog.com/~techart



No Keyboard - No Mouse

KBM-AT A PCAT or PS/2 with a KBM-AT boots perfectly without a keyboard or mouse; NO "keyboard error" message! Hot-connect a keyboard to the KBM-AT anytime later. The serial mouse driver boots perfectly with the "driver installed" message. Works great with PC's connected to a common keyboard, mouse & monitor! PC's in remote applications too.

PRICE \$74.80 each

SPECIAL buy 2 (or more) **\$68.80** each

CYLAB
incorporated

513 271 4436 fax 271 3933
5725 Dragon Way
Cincinnati, Ohio 45227

SURVEILLANCE FREE CATALOG



Color Camera \$149 LCD TV/Monitor \$99
2.4 GHz Video \$139
Over 200 Items!
Night Vision \$169 IR Flashlight \$35 NannyCam \$99

FULL ONLINE CATALOG
www.mscelectronics.com

MSC Electronics

PO BOX 461 Jessup, MD 20794

(301) 497-1600

FAX (301) 497-1925



www.jm-micro.com

PIC In-Circuit Emulator

for the PIC16Cxx from \$295

PIC Programmer \$155

80C552 (8051) Development

Training System \$235

68HC11 SBC \$120

ROMY-16 EPROM Emulator

from \$195

**Universal Microprocessor
Simulator/Debugger (including
Assembler, and Disassembler)**

\$100 each CPU

J&M Microtek, Inc.

83 Seaman Rd, W Orange, NJ 07052

Tel: (973) 325-1892 Fax: (973) 736-4567

Notch Filters

Test Chips



Filter Kits
1 to 2 \$20 each
3 to 9 \$15 each
10 to 20 \$9 each
21 or more \$7 each

**Adult Wholesale
Video's**

\$ 379.00

Free Shipping

Video Media

P.O. Box 93/6025

Margate, FL 33093-6025

(954)-752-9202



www.nutnet.com

LASER MODULE



Auto Power Control
Collimated Laser
Compact Size
100,000 hr lifetime
No Electronics Required

Visible Laser Modules (635-670 nm)
TTL Modulated Laser Modules
Line Generator Laser Modules
Infrared Laser Modules (780-830 nm)

from
\$29 (US)

LASER POINTER



Focus Adjustable
Elegant Design
Solid Metal Body

Pen Style Laser Pointer (1500 ft visibility)
Key Chain Laser Pointer (1500 ft visibility)
Available in silver and, black finish.

\$19.95 (US)

World Star Tech.

Tel: (416) 204 6298 Fax: (416) 596 7619

http://www.worldstartech.com

Ask for free catalog

e-mail: info@worldstartech.com

Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"
* Or Photocopy
** Use standard
household iron
or P-n-P Press.

1. LaserPrint*
2. Press On**
3. Peel Off
4. Etch



Use Standard Copper Clad Board
20 Shts \$30/ 40 Shts \$50/ 100 Shts \$100
Visa/MC/PO/Ck/MO \$4 S&H

Techniks Inc.
P.O. Box 463

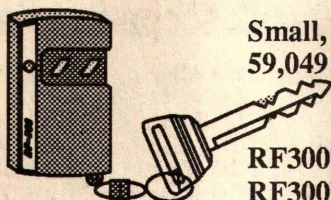
Ringoes NJ 08551

ph. 908.788.8249 fax 908.788.8837

http://chelsea.ios.com/~techniks

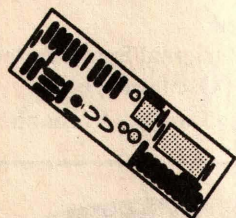
Retail Dealer Inquires Invited

Miniature Transmitters and Receivers



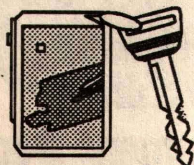
Small, Attractive, High End Quality, 2 Channel 318 MHz Transmitter
59,049 Settable Codes, 120'-300' Range, 1-1/4" x 2" x 9/16", Assembled

	Qty	1	5	10
RF300T 150' Range Transmitter		24.95	19.95	15.95
RF300XT 300' Range Transmitter		29.95	24.95	19.95



Small, High End Quality, 2 Channel Receiver for the RF300 Transmitters
1-1/4" x 3-3/4" x 9/16" PCB w/ .1" spaced pads for standard connectors
Input: 8-24 vdc Output: Gated CMOS Momentary and Latching Lines

	Qty	1	5	10
RF300R Receiver, Fully Assembled		24.95	20.95	16.95
RF300RK Receiver, Complete Parts Kit		19.95	15.95	12.95
RF300PA Pre-Amplifier. Doubles Range		14.95	11.95	9.95



Small, Economical, Single Channel Transmitter and Receiver Set
Set Code, 60' Range, 1-7/8"x2-3/8"x7/16" (T), 2"x2-3/4"x9/16" (R)
Receiver Input: 5 vdc Output: Gated TTL Momentary Line

	Qty	1	5	10
RF60 Transmitter and Receiver Set		24.95	19.95	14.95

Add \$ 4 shipping for first item + \$ 1 for each additional item. Ca. residents add 8.25% tax
Visa, Mastercard, Money Orders Personal Checks and Cash C.O.D.s

Visitect Inc.

P.O. Box 14156 Fremont, CA. 94539 (510) 651-1425 Fax (510) 651-8454

CIRCLE 310 ON FREE INFORMATION CARD

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call C&D ELECTRONICS
1-888-615-5757 M-F 10a-6p

ULTIMATE HOME SHOP

Complete tools for metal & woodworking



Call 1-800-345-6342 or write: @Smithy Dept. ENS, PO Box 1517 Ann Arbor, MI 48106-1517

SINGERS! REMOVE VOCALS

Unlimited, Low Cost, Instantly Available Background Music from Original Standard Recordings! Does Everything Karaoke does... Better and gives you the Thompson Vocal Eliminator! Free Brochure & Demo Tape. LT Sound Dept EN 7988 1st Parkway, Lithonia, GA 30058 Internet: http://www.LTSound.com 24 Hour Demo/Info Request Line (770) 482-2485 • Ext 72 When You Want Something Better Than Karaoke!

SCIENCE FAIR ELECTRONICS

One of the largest electronic kit selection

Address: 9740 CAMPO RD. #209
SPRING VALLEY, CA 91977

PHONE: (619) 668-0078
TOLL FREE 1-800-475-0349
FAX: (619) 668-0054

We Carry Electronic Kits, Robots, Motors, Tools, Test Equipment, batteries, etc.

To receive a **FREE CATALOG** fax or mail your address with phone number to the address above and you will automatically become a member with no extra charge.

PIC 16C/F84 Development Programmer

• Software is for the 16C84 & 16F84 • Software can read, verify & load (Win95/3.x/Dos) • EEPROM space, program space & configuration fuses can be treated separately • Separate erase command • Test command to test Programmer & cable • Vpp (programming voltage) is under software control • Attaches to parallel printer port of PC • 9V battery powered • Microchip data sheets on disk • 16F84 programs made by other assemblers can also be used with programmer • All components, PCB and Instructions included • 16F84-4MHz PIC included.

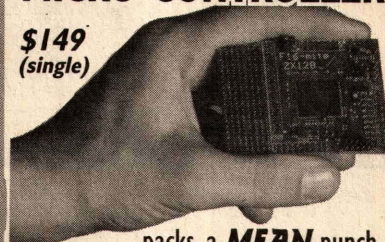
Running Lights Kit

Ideal for parties, discos, shop windows and X-mas decorations. 8 LEDs switch on and off in 10 push button selectable patterns. 8 different speed levels for a total of 80 combinations! Includes PCB, components & instructions. Uses a 51 microcontroller. Can operate light bulbs by using TRIACs. (8xTRIACs is \$6 extra) *S&H to Canada is \$8

Orders only: 1-888-549-3749 (USA & Canada)
Info: (330) 549-3726 For more information and lots of other products visit us at: www.electronics123.com
Amazon Electronics, Box 21 Columbiana OH 44408

FRIENDLY LITTLE MICRO CONTROLLER

\$149 (single)



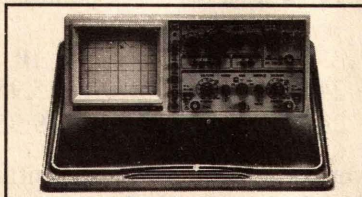
...packs a **MEAN** punch
a.k.a. "Steroid Stamp"

- 39 I/O + 8 A/D (10 bit) •
- 128K SRAM + 128K Flash •
- LCD/Keypad Interface •
- Fast 16 bit Motorola CPU •
- Affordable C Compiler •
- Comprehensive s/w Library •

* Intec Automation Inc. v: 250-721-5150
www.steroidmicros.com fx: 250-721-4191

New and Pre-Owned Test Equipment

Goldstar



Model OS-5100 → \$899.00
Full 100 MHz Bandwidth!

- Dual-Channel, High Sensitivity
- TV Synchronization Trigger
- Calibrated Delayed Sweep
- Includes Two Probes, 2 Year Warranty

Spectrum Analyzer
 Avcom PSA-37D

Satellite Downlink
 Installation
 Maintenance & Service

- Band 1 10 - 1750 MHz
- Band 2 3.7 - 4.2 GHz
- Built-in DC Block & Power for LNA/LNB's
- Line or Battery Powered

Only \$2,475.00!

**We Buy Surplus
 Test Equipment**

Leader CATV Signal Level Meter Model LF 941

- ✓ TV/CATV Coverage from 46 - 870 MHz
- ✓ Video/Audio Carrier Measurements **\$695.00!**

Just Released! → "Series III" Multimeters

Fluke Model 87III \$319.00 !!!

**SIMCHECK® II PLUS
 Module Tester**

- * Tests SIMMs/168 p DIMMs
- * Stand alone/portable
- * Identifies Module properties
- * Advanced Setup Capabilities

Only \$2750.00!

(1-800-996-3837)

See us on the Web!
www.fotronic.com

Test Equipment Depot

A FOTRONIC CORPORATION COMPANY

99 Washington St. Melrose, MA 02176

(781) 665-1400 • FAX (781) 665-0780

email: sales@fotronic.com



TOLL FREE 1-800-99-METER

CIRCLE 333 ON FREE INFORMATION CARD

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info

Call **1-800-526-2532** for Order and Free Catalog

DMM	LCR/COUNTER	FLUKE	SPECIALTY
DMM-89S (\$179.00): true rms, AC/DC (V,A), Ω , bar graph, freq, capac, dBm, logic, diode DMM-23T (\$99.95): 4 1/2 digit, true rms, high resol (10 μ V, 10nA, 10m Ω), hFE, diode, contin. DMM-20 (\$74.95): AC/DC (V, A), Freq, cont., Capac, Induct., Ω , hFE, diode, duty cycle DMM-122 (\$59.95): DC/AC(V,A), Ω , hFE, diode, capacitance, freq, logic, continuity DMM-123 (\$44.95): DMM + capacitance, DC/AC(V,A), Ω , hFE, diode, continuity DMM-10 (\$19.95): 3 1/2 digit, DC/AC V, Ω , hFE, diode, signal output(+3V,-0.5Vsq., 50% duty)	CAP-15 (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment. LCR-24 (\$119.95): 0.1 μ H-200H, 0.1pF-2000 μ F, 0.01 Ω -20M Ω , diode test. <i>New Model.</i> LCR-131D (\$219.95): autorange, 0.1 μ H-10kH, 0.1pF-10mF, 1m Ω -10M Ω , Q Factor, serial/parallel, 120Hz/1kHz testing mode. FC-1200 (\$129.95): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)	12B \$ 94.95 70-III \$ 99.00 73-III \$125.00 75-III \$155.00 77-III \$173.00 79-III \$195.00 87-III \$325.00 92B-III \$1,445 96B-II \$1,695 99B-III \$2,095 105B \$2,495 123-III \$1,130 863E \$555 867B \$740	AC Current Probe \$34.95 DC/AC Current Probe \$79.95 Mini AC Clamp \$59.95 AC Clamp w/temp \$89.95 DC/AC Clamp \$109.95 Thermometer \$69.95-\$89.95 IR Thermometer \$189.95 Sound Level Meter \$169.95 Tachometer \$169.95-\$219.95 EMF Tester \$69.95 Pressure Meter \$299.95 Watt Meter \$129.95 High Voltage Probe \$59.95 pH Meter \$79.95 Light Meter \$79.95-\$89.95

Single Output DC Power Supplies	Triple Output	AUDIO/RF/FUNCT. GEN.
• Constant current, constant voltage mode • Short Circuit and overload protected Analog Meters Display PS-303 (\$159.00) 30V/3A PS-305 (\$219.95) 30V/5A PS-8112 (\$399.95) 60V/5A PS-1610 (\$289.00) 16V/10A PS-8107 (\$399.95) 30V/10A Digital Volt. Analog Current PS-8200 (\$179.95) 30V/3A PS-8201 (\$239.95) 30V/5A Digital Volt. & Current Display PS-8300 (\$199.95) 30V/3A PS-8301 (\$259.95) 30V/5A	• Independence or Tracking operation • Parallel to double current output (PS-8102 & PS-8103 only) Triple Output (Analog displays) PS-8102 (\$399.95) 30V/3A/30V/3A PS-8103 (\$489.95) 30V/5A/30V/5A Digital Displays PS-8202 (\$499.95) 30V/3A/30V/3A PS-8203 (\$549.95) 30V/5A/30V/5A	RF Generator • SG-4160 (\$124.95) 100kHz-150MHz sinewaves in 8 ranges SG-4162AD (\$229.95) with 6 digit counter Audio Generator • AG-2601 (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp squarewave AG-2603AD (\$229.95) with 6 digit counter Function Generator • FG-2100A (\$154.95) 0.2Hz-2MHz, 5mV-20Vpp 863E (\$329.95) Sweep 0.5Hz-5MHz

20 MHz Scope	Cursor Readout	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
OS-620 \$324.95 • Most economical scope • Dual CH/X-Y operation • 1 mV/div sensitivity • Z-axis input, CH1 output • TV syn, ALT trigger • 2 probes (x1, x10)	OS-626G \$599.95 • Readout & Cursor meas • Dual CH / Delay sweep • Built-in delay line • ALT trigger, Hold-Off • Z-axis input, CH1 output • 2 probes (x1, x10)	• 2 variable out 0-30V, 0-3A • One fixed 5V, 3A output • Auto track, serial, parallel • Const. volt, current mode • 4 analog or 2 digital display PC-3030 (\$499.95) PC-3030D (\$549.95) digital	• Const voltage, current mod • Voltage regulation $\leq 0.01\%$ • Current regulation $\leq 0.2\%$ PS-1830 (\$198.95) 18V/3A PS-1850 (\$214.95) 18V/5A PS-1830D (\$214.95) 18V/3A PS-1850D (\$244.95) 18V/5A	• Auto serial/parall. (PPT ser) • Auto track (PPT series), IEEE-488.2 and SCPI compatible command set PPS-1860G (\$1,149.95) 18V/6A PPS-3635G (\$1,149.95) 36V/5A PPT-1830G (\$1,499.95) 18V/3A PPT-3615G (\$1,499.95) 36V/1.5A	FG-8020G (\$209.95) • 0.02Hz-2MHz w/counter • Sine/Sqr/Tri/pulse/Ramp FG-8020C (\$209.95) • 0.02Hz-2MHz w/counter FG-8050 (\$449.95) Sweep • 0.05Hz-5MHz w/counter • INT/EXT AM/FM mod	DM-8034 (\$179.95) 3 1/2 dgt • AC/DC(V,A), C, Ω , diode DM-8040 (\$339.95) 3 3/4 dgt • ACV to 50kHz, true rms DM-8055G (\$889.95) 5 1/2 dgt • 0.006% accuracy, GPIB • dBm, auto, REL, min/max

ALFA ELECTRONICS
 P.O. BOX 8089
 PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135

FAX: 609-897-0206

E-mail: sales@alfaelectronics.com

Call / Write / Fax / Email for FREE CATALOG

Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.

1 Year Warranty (2 Years for GW/Instek)

CIRCLE 213 ON FREE INFORMATION CARD

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM
WE BUY TEST EQUIPMENT AND COMPONENTS.
VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 8901A MODULATION ANALYZER	\$2100.00
HP 8165A 50MHZ PROG. SIGNAL SOURCE	\$1700.00
HP 436A RF POWER METER NO CABLE OR SENSOR	\$700.00
HP 8559A/853A .01-21GHZ SPECTRUM ANALYZER	\$3500.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2900.00
HP E3617A 0-60VDC 1AMP DIG. READOUT	\$275.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1100.00
HP 3325A OPT.01 HIGH STABILITY TIME BASE	\$1350.00
HP 6034A 0-60V 10A DIG DISPLAY	\$900.00
HP 5335A 200MHZ COUNTER	\$800.00
HP 3488A SWITCH/CONTROLLER	\$550.00
HP 2804A QUARTZ THERMOMETER	\$300.00
HP 4140B PICO-AMP METER/DC VOLTAGE SOURCE	\$3500.00
HP 54201A 300MHZ DIG. OSCILLOSCOPE	\$1500.00
HP 8011A PULSE GENERATOR	\$250.00
HP 3455A DMM	\$250.00
HP 3497A DATA ACQUISITION/CONTROL UNIT	\$600.00
HP 86290A RF PLUG IN 2-18GHZ	\$1200.00
HP 86603A RF PLUG IN 1MHZ-2.6GHZ	\$1700.00
HP 86601A RF PLUG IN .01MHZ-110MHZ	\$400.00
HP 86632B AM/FM MODULATION PLUG IN	\$750.00
HP 1631D LOGIC ANALYZER	\$300.00
HP 8640B OPT.002 1GHZ AM/FM SIGNAL GEN.	\$1400.00

TEK 2465A 350MHZ 4CH. OSCILLOSCOPE	\$3500.00
TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1700.00
TEK 465 100MHZ OSCILLOSCOPE	\$400.00
TEK 475 200MHZ OSCILLOSCOPE	\$500.00
TEK 496P 1KHZ-1.8GHZ SPEC. ANALYZER	\$4000.00
TEK 576 CURVE TRACER	\$2500.00
TEK CG5001 PROG.O-SCOPE CAL.GEN.	\$2000.00
TEK PS5010 POWER SUPPLY	\$450.00
TEK 7L12 SPECTRUM ANALYZER	\$1350.00
TEK 485 350MHZ OSCILLOSCOPE	\$650.00
TEK 454 100MHZ OSCILLOSCOPE	\$300.00
TEK TM5006 POWER FRAME	\$250.00
TEK 11A32 400MHZ 2CH AMPLIFIER	\$750.00
TEK 11A34 300MHZ 4CH AMPLIFIER	\$900.00
TEK 11A52 600MHZ 2CH AMPLIFIER	\$400.00
TEK 11A71 1GHZ 1CH AMPLIFIER	\$300.00
TEK 11302A 500MHZ PROG.O-SCOPE FRAME	\$750.00
TEK 11401 500MHZ PROG.O-SCOPE FRAME	\$750.00
TEK 11402 1GHZ DIG.PROG.O-SCOPE FRAME	\$1000.00
TEK TM506 POWER FRAME	\$100.00
TEK 7104 1GHZ OSCILLOSCOPE FRAME	\$1250.00
TEK AM503 CURRENT PROBE AMPLIFIER	\$350.00
TEK 7B92A TIME BASE	\$125.00
TEK 7S12 SAMPLING PLUG IN	\$350.00

GALEP-III Pocket Multiprogrammer

This size
fits all!



- Programs 8-bit and 16-bit EPROMs, EEPROMs, Zero Power RAMs, Flash, serial EEPROMs • GAL, PALCE, ATF • 87xxx, 89xxx, PIC12/16/17Cxx • All DIL devices without adaptor • Lightning fast parallel data transfer (e.g. 27C512 read/compare 2 sec!) • Power supply independent due to rechargeable battery • Uses PC printer port • Hex, JEDEC, and binary file formats • Hex and fusemap buffer editor • Split & shuffle for 8-bit, 16-bit and 32-bit targets • Runs under Win3.1, 95, 98 • Remote control by DDE scripts • Designed for the future due to flexible pin driver technology - new devices will be added every month • Device list, demo software and lifetime free updates from our website www.conitec.com

GALEP-III Set with cable, battery, recharger \$389.00
PLCC Adaptor for 8-bit EPROMs / 16-bit EPROMs / GALs each \$149.00

CONITEC 1951 4th Ave, Ste 301 • San Diego, CA 92101
Tel: (619) 702-4420 • http://www.conitec.com

MICROTEST INC. CABLE TEST CHIPS FROM \$9.95

WE STOCK A COMPLETE LINE OF CHIPS
WE ALSO HAVE CRYSTAL 119.MHZ2117.MHZ

WARNING:
ANYONE IMPLYING ILLEGAL USE WILL BE DENIED SALE. WE SELL PRODUCTS ONLY TO TECHNICIAN OR REPAIR FACILITIES
ALL ORDERS SHIP VIA UPS/ECT
THE BEST PRICE IN THE MARKET
WE INCLUDE SWITCH & RESISTOR
MON-SAT 8 AM-7 PM EST .TECH SUPPORT
E-MAIL WWW.MICRO-TEST@AOL.COM

**FOR ORDERS
1800-931-9440**

CABLE TV EQUIPMENT

Converters, Test Cubes & Chips

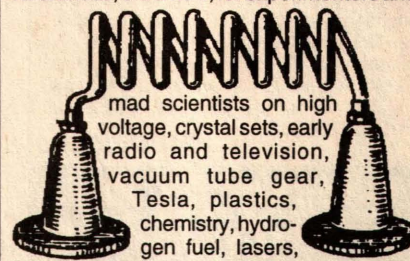


1 Year Warranty
30 Day Money
Back Guarantee

"ABSOLUTE LOWEST
WHOLESALE &
RETAIL PRICES"
CABLE U.S.A.
1-888-388-CUBE

SECRETS!

Unusual, detailed how-to books, manuals, references, old & new, for experimenters and



mad scientists on high voltage, crystal sets, early radio and television, vacuum tube gear, Tesla, plastics, chemistry, hydrogen fuel, lasers, booze, solar cells, embalming, telegraphy, more! Highest quality how-to! Guaranteed! Big illustrated catalog! fax:815/935-5477 Write! • http://www.lindsaybks.com

Lindsay's Technical Books
PO Box 538-EBH, Bradley, IL 60915

FACTORY SALE

Board Camera • 1/3" CCD, 430 Line horiz.
• 12V/100mA Lens, 3.6mm/F2.0.
• Lens and Pin hole types.
• \$43@5pcs, \$38@10pcs

Wireless Camera • 2.4 GHz transmitter & receiver.
• Capable handling total of 4 wireless cameras. Range: > 300'
• Built-in CNL100,380 TV line
• \$189@5pcs, \$179@10pcs
• Additional camera \$99@10pcs

Hidden Camera • Built-in pin hole CCD
• Lens size: 3.6 mm / F2.0
• 5 1/2"(D) X 1.7"(H)
• \$79@5pcs, \$69 @10pcs

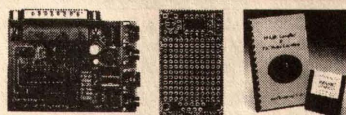
Quad System • 4 BNC/RCA input
• 2 BNC/RCA Quad output
• \$179@5pcs
• Also Available 8-1Video Switcher

www.mat-co.com, sales@mat-co.com

MATCO Inc.

(800)440-0299 FAX: (630)350-9546

Low Cost PICmicro Tools



EPIC Pocket PIC Programmer - \$59.95
• Programs PIC12C50x, 67x, 16C55x, 6x, 7x, 8x
PICProto Boards - \$8.95 to \$17.95
PicBasic Compiler - \$99.95
new! PicBasic Pro Compiler - \$249.95

BASIC makes it easy for you to program the fast and powerful Microchip PIC microcontrollers.
• Expanded BS1/2 compatible instruction set
• True compiler provides faster program execution and longer programs than BASIC interpreters

microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933
(719) 520-5323 fax (719) 520-1867
http://www.melabs.com

Quality Microwave TV Systems

**WIRELESS CABLE - IPTS - MMDS
ATV - INTERNATIONAL - DIGITAL**
Amplifiers • Antennas • Books • Components
• RF Frequency 2100-2700 Mhz
• SASE For "FREE" Catalog or Send \$1
PHILLIPS-TECH ELECTRONICS
P.O. Box 13074 • Scottsdale, AZ 85267-3074
CATALOG/INFO: 602-947-7700
ORDER LINE: 800-880-MMDS
FAX LINE: 602-947-7799
WEBSITE: www.phillips-tech.com
E-MAIL: product@phillips-tech.com
Visa • M/C • AmEx • Discover • COD's • Quantity Pricing

HI-TECH SURVEILLANCE

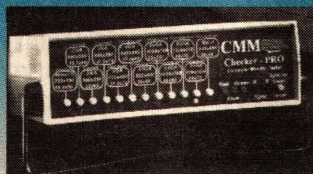
Pinhole Cameras, Recording Devices, Bug Detectors, Lasers, Lockpicks, Pen Knives, Tracking Devices, Wireless Mics, Books/Videos, plus much more!!!!

FOR CATALOG - SEND \$5.00 TO:

Spy Way
P.O. Box 61805, Jax, FL 32236

CMM Monitor/TV Test Equipment

Checker Pro



There is the Computer monitor tester you have been asking for. Sweep rates to 15-64 kHz, MGA, CGA, VGA, lots of MACs, even video (mono), GRAY SCALE, quick push button operation, "Energy Star" testing, and more. AC or Battery.

PRICE: \$499.95

Checker 12e



Now you can repair and test Computer monitors with ease. With sweep rates up to 64KHz., eight step gray scale, white screen, single color mode. Mac II, EGA, CGA support, you can run almost ANY PC monitor. And it is EASY to use. Color front panel displays show just what you should see. Don't let its' small size fool you. It is the most powerful handheld available, and it supports ALL basic VGA modes (some don't). It is suitable for bench or field operations. Battery or AC operation.

PRICE:\$295

Checker TV Pro & TV Jr.



The TV Pro is just the tool for your repair bench. It provides Video, S-Video, and RF outputs. It also has the most important pattern, GRAY SCALE! You can't set up a color TV without it. All with NTSC standards and COMPLEX sync. The RF output also includes an audio tone and STEREO signaling. With colorbars, gray scale, crosshatch with dots. you can set and test quickly.

Checker TV Pro...PRICE: \$499.95

The TV Jr is a small NTSC video generator. with colorbars crosshatch with dots. white. red blue green. and black screens. Small enough to fit in your pocket. powerful enough to drive the largest projection TV!

Checker TV Jr....PRICE: \$129.00

Computer & Monitor Maintenance, Inc.
1-800-466-4411 • 770-662-5633
<http://www.computermonitor.com>

CLASSIFIED

AUDIO-VIDEO-LASERS

Unique Video Products Pattern Generators with character identification, composite, s-video, RGB, distribution amplifiers, kits also available, FREE catalog, **GEKCO Labs**, PO Box 642 Issaquah, WA 98027-0642, 888-435-7221, www.gekco.com.

BUSINESS OPPORTUNITIES

Have a New Product/Idea? Full Marketing and Patenting Services. Call 1-800-846-8368 Ext. 303. Free Information Kit.

\$400 WEEKLY ASSEMBLING Electronic circuit boards/products from home. For free information send SASE: Home Assembly-EN Box 216 New Britain, CT 06050-0216.

Descramblers, Converters, Activators, Rft's, Ftg's, Bullet Snoopers. All options explained, best prices, services, 2yr warranty, free catalog 1-800-854-1674, www.resourceleader.com/aapc.

Microwave oven repair course. Universal training manual, schematics, free microwave power detector, technician's certificate. \$60.00, **MOTS TECH**, Box 29141, Thunder Bay, Ontario, Canada. P7B6P9.

Learn Electronics. Home study. Outstanding careers. Free literature. **P.C.D.I.**, Atlanta, Georgia. Call 800-362-7070. Dept. ELA342.

CABLE TV

Bewildered about descramblers? Call for your options. Same day shipping. M-F 9-8, SAT 12-5. **Global Electronics** 1-888-221-8365.

CABLE TV Descramblers. One piece units. Scientific Atlanta, Jerrold, Pioneer, and others. Lowest prices around. **Precision Electronics** Houston, TX. Anytime. 1-888-691-4610.

CABLE TV Signal Eliminator - Powerful, user tunable filter for removing severe interference OR unwanted channels! Eight models, for channels (2-3) (4-6) (7-13) (14-17) (18-22) (23-29) (30-36) (95-99). Each \$30, add \$4 for S/H. Quantity discounts. Money back guarantee. Visa, Mastercard or check. COD \$5 extra. Visit starcircuits.com. **Star Circuits**, PO Box 94917, Las Vegas, NV 89193. 1-800-433-6319.

Free Cable Descrambler Plans. For Details Write: **Sierra Publishing**, 909 E. Yorba Linda Blvd., Suite H-181, Dept ENW, Placentia, CA 92870.

CUBE for Jerrold Model CFT-2200, 2014, 2024, 2254, Pioneer 6300-6310, Auto-Multimode, Zenith ST-1600 \$175.00. Lowest price call 800-822-8530.

CABLE TV EQUIPMENT & ACCESSORIES. Wholesalers Welcome! 30 Day Moneyback Guarantee! Free Catalog! **PROFORMANCE ELECTRONICS, INC.** 1-800-815-1512.

CABLE DESCRAMBLING, New secret manual. Build your own Descramblers for Cable and Subscription TV. Instructions, schematics for SSAVI, Gated Sync, Sinewave, \$12.95, \$2 postage. **CABLETRONICS**, Box 30502R, Bethesda, MD 20824.

Wholesale to the public. The industries leading distributor of cable electronics is now open to the public. We will beat all competitors pricing. **Dimension** 1-800-474-2343.

NEW! Cellphone E.S.N. readers \$250 each, cell phone programmers \$175 each, cell phones \$25 each, DSS satellite dish card readers and programmers \$125 each, credit card readers \$250 each, Cable T.V. notch filters 50 cents each, converter boxes \$50 each, magnetic strip card readers for ATM machines, bank cards, drivers license, and all types of data acquisitions all under \$200 each. You pay these super low prices when you deal directly with the manufacturers. When you order "Direct Connection" a 150 page directory published by Ed Treki Publications, you will receive the largest collection of names, addresses, and phone numbers of all the leading American and International manufacturers of these products never before available. Stop paying second, third and fourth hand prices and deal directly with the source!!! Order your copy of "Direct Connection" today for only \$59.95 plus \$5 shipping. All orders are sent C.O.D. Please call Ed Treki Publications 24 hour order hot line 914-544-2829.

Cable TV descramblers. All major brands. Have make and model number of converter used in your area when calling. Quantity discounts. **K.D. VIDEO**, 1-800-327-3407.

Descramble cable with simple circuit added to RadioShack RF Modulator and using VCR as tuner. Instructions \$10.00. **TELCOM** Box 832-1 Brusly, LA 70719

Free Cable TV t-shirt with the purchase of a radio frequency test cube, converter or video stabilizer. We will beat any price!!! **Cable USA, Inc.** 1-888-388-CUBE.

NEW! Jerrold and Pioneer wireless test units \$125 each, also 75DB notch filters \$19.95 each, quantity pricing available, please call **KEN ERNY ELECTRONICS**, 24 hour order and information hotline 516-389-3536.

All cable TV boxes. We'll beat any price. 30 day trial, 1 year warranty. 1-800-538-CABLE(2225).

CB-SCANNERS

CB Radio Modifications! Frequencies, kits, high-performance accessories, books, plans, repairs, amps, 10-Meter conversions. The best since 1976! Catalog \$3.00. **CBCI**, Box 1898EN, Monterey, CA 93942.

CB Trick Books, three books 1, 2 and 3. Each book \$19.95 each. Repairs, tune-ups, and amplifiers. Send money order to **Medicine Man CB**, P.O. Box 37, Clarksville, AR 72830.

MISC. ELECTRONICS FOR SALE

Voltage Surge Protector can save you hundreds and thousands of costly repair or replacement. Protect your VCR, TV, stereo, computer. Don't be Zap. Only \$19.95 plus p/h \$3.50 to R.E.P. PO Box 4411, Columbia, SC 29204.

PLANS-KITS-SCHEMATICS

AWESOME KITS: Voice Changers, Levitators, Lasers, Gas Sensors and more! Catalog \$1.00. **LNS Technologies**, PO Box 67243, Scotts Valley, CA 95067 www.cnet.com/~LNSTECH.

CATALOG: Broadcasting/micro transmitters, amplifiers, antennas. **Start your own radio station books.** Audio, TV, Ham, CB, Surveillance, Science projects and more. www.panaxis.com **PAN-COM Int'l**, PO Box 130-1, Paradise, CA 95967.

ELECTRONIC PROJECT KITS: 49 McMichael St, Kingston, ON., K7M 1M8. \$3.00 catalog. www.qkits.com. **QUALITY KITS.**

NEW AM Broadcast Band Transmitter kit from SEASIDE ELECTRONICS. Be your neighborhoods D.J., send check or M.O. for \$32.95 + \$10.00 S/H to 6920 Airport Blvd, Suite 117-114 Mobile, AL 36608 or call in COD orders to (334)341-0740. For full catalog send \$2.00 to above address. **WE BUILD ANY KIT, CALL FOR PRICE!**

SATELLITE EQUIPMENT

FREE CATALOG - Satellite TV/GPS-DIY. Technical Books, Installation Videos, Computer Analysis Software www.baylin.com 800-843-2425.

SKYVISION! Your Satellite Home Entertainment Source. **Best values:** DBS and C/Ku-band equipment, including 4DTV. Most complete selection: Parts-Tools-Upgrades-Accessories! **Free** Discount Buyer's Guide. Call 800-543-3025. International 218-739-5231. www.skyvision.com.

DSS Hacking: How to construct and program smart cards, with pic16C84, PCB layout, Complete DSS system schematics, \$16.95. Software \$25. **CABLETRONICS** Box 30502R, Bethesda, MD 20824

TEST EQUIPMENT

TEST EQUIPMENT SALE! Complete listing at <http://www.astglobal.com> or call **NOW** to receive list by fax or mail. **AST GLOBAL ELECTRONICS:** Voice: 888-216-7159, Fax: 814-398-1176, e-mail: sales@astglobal.com

WANTED

WANTED: USED TEST EQUIPMENT. TURN IDLE OR EXCESS EQUIPMENT INTO CASH. **AST GLOBAL ELECTRONICS:** Voice: 888-216-7159, Fax: 814-398-1176, e-mail: sales@astglobal.com

CALLER ID ON TV

NEW! CALLER-TV \$49.95 NO MORE INTERRUPTIONS! Know who's calling immediately. Secure internet ordering www.caller-tv.com, 520-544-4567.

PATENT

BEST RESULTS for design, utility, and plant patents. Best patent & trademark services/free information. 1-877-418-0800/P.O. Box 15607, Arlington, VA 22215-0607.

SCRAMBLING NEWS

Pay TV and Satellite Descrambling: 1999 Edition. All the latest cable and satellite fixes. Free catalog. 941-646-2564 or www.scramblingnews.com.

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

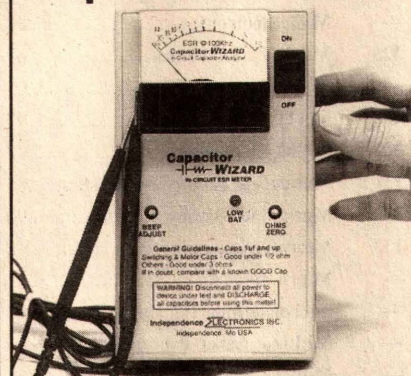
INSPIRATIONAL STORIES by Frank Jakubowsky. \$10.00, Jesus Books, 1565 Madison, Oakland, CA 94612-4511.

MAJOR RETAILER WANTS Your Inventions! Send \$10.00 mailing fee to: Paradise, PO Box 11, Berwick, PA 18603.

ELECTRONIC SHOPPER

Find Bad Capacitors

In-Circuit with the Capacitor Wizard



The Capacitor Wizard is an extremely **FAST** and **RELIABLE** device designed to measure ESR (Equivalent Series Resistance) on capacitors of 1uf and larger **"IN CIRCUIT"**, eliminating the need to remove the capacitor for accurate tests. The Capacitor Wizard finds **BAD caps IN CIRCUIT** that even **VERY EXPENSIVE** cap checkers **MISS ENTIRELY**, even out of the circuit!! Standard capacitor meters cannot detect any change in ESR therefore they miss bad capacitors leading to time consuming "Tough Dog" repairs. *Technicians say it is the most cost effective instrument on their workbench.*



Made in the USA

Order Today

Only \$179.95

Call 1-800-394-1984

<http://www.heinc.com>

Int. # 316-744-1993

Fax 316-744-1994

6222 N. Oliver, Kechi, KS 67067

30 day money back guarantee



SURVEILLANCE

The Latest High Tech Professional Electronic Devices

Our latest catalog offers a **HUGE** selection of surveillance, counter-surveillance/privacy devices: **pinhole camera \$129⁰⁰**, hidden video, **"realtime" 12-Hour telephone recorder \$139⁰⁰**, 12 hour VOX recorder phone call register, scanners, bug/phone tap detectors, voice disguisers, locksmithing tools, vehicle tracking, wireless video, and much more. Wholesale/retail. **We will not be undersold.**

Catalog \$5.00 or
www.spyoutlet.com

SPY OUTLET

PO Box 337, Buffalo NY 14226
(716) 691-3476/(716) 695-8660

SURVEILLANCE HIDDEN CAMERAS
DIRECT FROM MANUFACTURER—BEST PRICE IN THE MARKET

Ultra miniature hidden camera, in dome, smoke or motion detector w/ mic. B/W or Color. Wide view angle. Low light sensitivity + super sharp images, plus video and audio output. From \$159.00. Also 1/2" S/W board cameras w/mic, starts at \$79.00 USD. Wireless hidden camera, start at only \$249.00 USD. Plus \$5.95 for S/H. Wholesale/Retail Welcome. COD, Check, Money Order or Visa/MC.

BOLIDE INTERNATIONAL CORPORATION
PH: (800) 355-0895 or (626) 575-8178
9660 Flair Drive #218, El Monte, CA 91731
<http://www.bolideamazingproducts.com/>

CABLE TV CONVERTERS

Equipment & Accessories
Wholesalers Welcome

Call **C&D ELECTRONICS**
1-888-615-5757 M-F 10a-6p

Zagros Robotics

World Class Engineering and Programming

**ROBOTS
SONAR
OPTICS**

**Artificial
Intelligence**

PO Box 460342
St. Louis, MO 63146-7342
(314)768-1328

info@zagrosrobotics.com
www.zagrosrobotics.com

Cable T.V. Converters & Equipment

Lower
Prices
Dealer
Discounts
30-Day
Money back
1-year
warranty
MC, Visa,
AE, COD



No Florida Sales

www.cable4you.com
1-(800) 888-5585

January 1999, Electronics Now

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Free Information Number	Page	Free Information Number	Page
— Abacom Technology	74	— J-Tron Inc.....	85
— ABC Electronics	97	— James Electronics	93
— AES	90	— Lindsay Publications	97
213 Alfa Electronics.....	96	— Lynxmotion	88
214 All Electronics.....	79	— M ² L Electronics.....	88
— Allison Technology.....	64	325 Mark V Electronics	68
— Amazon Electronics.....	95	— MAT Electronics	5
270 American Eagle Publications	86	— MATCO Inc.	97
218 American Innovations.....	87	327 MCM Electronics.....	CV3
— Andromeda Research.....	90	251 Mendelson Electronics System.....	85
— Arrow Technologies.....	68, 85	334 Merrimack Valley Systems	90
313 Basic Electrical Supply	76	133 MicroCode Engineering	CV2
304 Beige Bag	70	— Micro Test.....	97
— Bossman Electronics.....	86	— microEngineering Labs.....	97
— Brand Electronics	67	— Midwest Laser Products	86
322 C&S Sales, Inc.	72	— Modern Electronics	68
— Cable USA	97	— Mondo-tronics Inc.	93
— Circuit Specialists.....	80	318 Mouser Electronics.....	68
— CLAGGK, Inc.....	11	— MSC Electronics	94
— Clearview Group	88	219 Netcom	67
— Cleveland Inst. of Electronics	3, 35	— NRI Schools.....	51
— Command Productions	74	— PC Boards	74
— Computer Monitor Maintenance	98	— Pioneer Hill Software	92
— Conitec.....	97	222 Polaris Industries.....	80
226 Consumertronics.....	70	315 Prairie Digital	67
228 Cool Amp Conducto Lube.....	64	264 Print (Pace)	62
— Crazy Liz's	93	266 Ramsey Electronics	63
— Cylab.....	94	283 Resources Unlimited.....	82
234 Dalbani Electronics	71	216 Roger's Systems Specialist.....	75
235 Danbar Sales	84	— Science Fair Electronics.....	95
— EDE - Spy Outlet.....	99	— Securetek	94
— Emac Inc.....	66	— Sil Walker	88
— Fair Radio	86	— Square 1 Electronics.....	66
335 Foley-Belsaw	89	314 Sun Equipment	77
— General Device Instruments.....	91	— Tech-Specialties.....	94
131 Global Specialties	7	— Techniks.....	94
— Grantham Col. of Engineering	8	— Technological Arts	94
329 Graymark International	81	311 Telulex.....	76
— Home Automation	85	333 Test Equipment Depot.....	96
331 Howard Electronics.....	65	217 Test Equipment Sales	66
— Howard Electronics.....	99	275 Timeline	81
— IEC.....	80	— U.S. Cyberlab	92
— Information Unlimited	84	282 Velleman	69
— Intec Automation	95	— Video Media	94
138 Interactive Image Technologies	CV4	259 Viewers Choice Electronics	61
— Intersoft	88	310 Visitect Inc.....	95
— Intronics, Inc.....	92	— Weeder Technologies	87
319 IVEX Design	91	132 Windjammer Barefoot Cruises	8
— J&M Microtek, Inc.....	94	— World Star Technologies	94

ADVERTISING SALES OFFICES

Gernsback Publications, Inc.
500 Bi-County Blvd.
Farmingdale, NY 11735-3931
1-(516) 293-3000
Fax 1-(516) 293-3115

Larry Steckler
publisher (ext. 201)
e-mail advertising@gernsback.com

Adria Coren
vice-president (ext. 208)

Ken Coren
vice-president (ext. 267)

Christina Estrada
assistant to the publisher (ext. 209)

Marie Falcon
advertising director (ext. 206)

Adria Coren
credit manager (ext. 208)

For Advertising ONLY EAST/SOUTHEAST

Megan Mitchell
9072 Lawton Pine Avenue
Las Vegas, NV 89129
Phone 702-240-0184
Fax 702-838-6924
Lorri88@aol.com

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
Midwest Advertising
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-847-559-0555
Fax 1-847-559-0562
bergenrj@aol.com

PACIFIC COAST

Anita Bartman
Pacific Advertising
Hutch Looney & Associates, Inc.
6310 San Vicente Blvd., Suite 360
Los Angeles, CA 90048-5426
1-323-931-3444 (ext. 227)
Fax 1-323-931-7309
janice@hlooney.com

Electronic Shopper
Joe Shere
National Representative
P.O. Box 169
Idyllwild, CA 92549-0169
1-909-659-9743
Fax 1-909-659-2469
Jshere@gernsback.com

Megan Mitchell
National Representative
9072 Lawton Pine Avenue
Las Vegas, NV 89129
Phone 702-240-0184
Fax 702-838-6924
Lorri88@aol.com

Customer Service
1-800-999-7139
7:00 AM - 6:00 PM M-F MST

MCM ELECTRONICS®

The Source For All Of Your Electronics Needs

When ordering, please provide this code: ► SOURCE CODE: ENS54

Prices Effective Dec. 3, 1998
through Jan. 29, 1999

For over 20 years, MCM has been the leading supplier to the electronics service industry. Huge inventory, rapid delivery and competitive prices have made MCM the choice for:

- Hobbyists
- Service Technicians
- Educators
- Installers

Discover the MCM difference, call today for your free catalog.



ONLY
\$59.95

Order #72-110

TENMA® 10A Variable Autotransformer

Vary line voltage between 0~130VAC. Perfect way to safely troubleshoot power supplies, regulators, output sections, etc. Built-in ammeter shows current draw to help identify shorts before they cause costly component failures. 10A max. **Regular price \$99.95**



ONLY
\$24.50

Order #72-2055

TENMA®

Portable DMM

Affordable hand held meter features 3 1/2 digit LCD display, DC voltage measurement to 600V, transistor and battery test. Input impedance 10Mohm. Includes holster and test leads. **Regular price \$31.95**



ONLY
\$49.95

Order #21-147

TENMA® Solder Station

Perfect for most soldering applications including SMD. Overheat protection with closed loop temperature control provides precise heat. Includes replaceable iron clad conical 3/8" tip. Linear LED display shows operating temperature. **Regular price \$79.95.**



ONLY
\$39.95

Order #21-935

Fluorescent Magnifier Lamp

5" lens has 3x magnifying power, ideal for any workbench. Spring balanced arm reaches 45". Includes 22W fluorescent tube. Beige finish. **Regular price \$49.95**



ONLY
\$7.50

Order #35-445

Hi-Fi Stereo Headphones

Professional-quality headphones feature 40mm super thin diaphragm drive units. Frequency response: 20Hz~20KHz. 9' straight cord has gold plated 3.5mm plug with 1/4" adaptor. **Suggested list: \$12.95**



your choice
ONLY
\$3.99

Order #20-2200 Order #20-2205
Envi-Ro-Tech™

Freezer and Duster

Save on these popular chemicals, essential to any tech bench. 10 oz. cans. **Regular price \$7.79**

Order #	Description	Mir. #
20-2200	Freezer	1672-10S
20-2205	Duster	1671-10S

ONLY
\$9.95

Order #28-2200

Multi Voltage Regulated Power Supply

Rotary selector switch selects 3, 4, 6, 7 1/2, 9 and 12V • Power projects or small battery operated devices • Color coded binding posts make connection easy • **Regular price \$16.95**

ONLY
\$22.50



Order #32-4430

Four-Way Audio/Video Amplifier

One input distributes four amplified outputs. Distributes Video and L/R audio via RCA jacks. Frequency range: 20Hz~10KHz. **Regular price \$30.75.**



**FREE
Catalog!**

1-800-543-4330

www.mcmelectronics.com

Hours: M-F 7 a.m.-9 p.m., Sat. 9 a.m.-6 p.m., EST.

**Same Day
Shipping!**

In stock orders
received by 5:00 p.m.
(YOUR TIME), are
shipped the same day.



MCM ELECTRONICS®

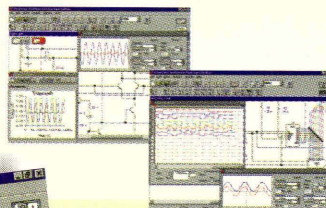
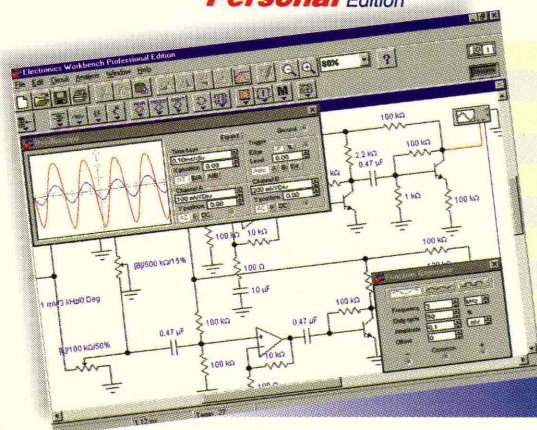
650 CONGRESS PARK DR.
CENTERVILLE, OH 45459

A PREMIER FARNELL Company

SOURCE CODE: ENS54

THE WORLD'S MOST POPULAR
DESIGN TOOL CHOSEN BY OVER
100,000 USERS!

Electronics Workbench® Personal Edition



TRUE MIXED ANALOG/DIGITAL
FULLY INTERACTIVE SIMULATION
PRO SCHEMATIC EDITOR
6 VIRTUAL INSTRUMENTS
ON-SCREEN GRAPHS
OVER 4,000 MODELS
8 POWERFUL ANALYSES
FREE TECHNICAL SUPPORT

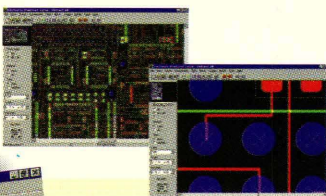
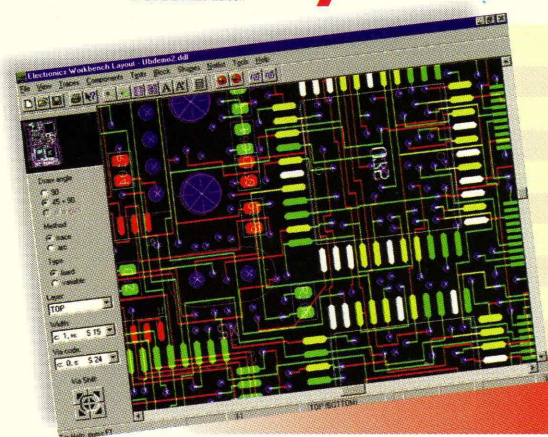
\$299

Full-featured schematic capture and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.



Electronics Workbench® Personal Edition **Layout**



AUTOROUTING
REROUTE WHILE MOVE
32 ROUTING LAYERS
50" X 50" BOARD SIZE
OVER 3,500 LIBRARY SHAPES
EXTENSIVE OUTPUT
REAL TIME DESIGN RULE CHECK
DENSITY HISTOGRAMS
FREE TECHNICAL SUPPORT

\$299

Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.

BUY BOTH AND SAVE! ~~\$598~~ \$548

CALL FOR INFORMATION
AND PRICING ON OUR
PROFESSIONAL EDITION.

800.263.5552

30-DAY MONEY-BACK GUARANTEE

Fax: 416-977-1818

E-mail: ewb@interactiv.com



For a free demo, visit our website at www.electronicworkbench.com